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The Commercial Fisheries of Temperate Western Australian Estuaries: Early Settlement to 1975

BY

R. C. J. LENANTON

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REPORT NO. 62

THE COMMERCIAL FISHERIES OF TEMPERATE WESTERN AUSTRALIAN ESTUARIES: EARLY SETTLEMENT TO 1975.

BY

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THE COMMERCIAL FISHERIES OF TEMPERATE WESTERN AUSTRALIAN ESTUARIES: EARLY SETTLEMENT TO 1975

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ABSTRACT

This report provides a quantitative description of the commercial estuarine fisheries of temperate Western Australia. An account is given of the long series of historical events which influenced the development of the fisheries and led to their current status. All available catch and effort data covering the years 1898-1975 are presented. The use of this long series of historical catch and effort data as an aid to the management of the estuarine fisheries resources is discussed. It is emphasised that interpretations of these data cannot be undertaken effectively without a knowledge of factors such as life history strategies, fishing practices and the market demand of the various species.

The present day state of the fishery is discussed. Indications are that some stocks of black bream and to a lesser extent yellowtail perch, which are essentially restricted to estuaries, have declined throughout the history of the fishery. Although catches of all other species have shown extensive annual and seasonal fluctuations, no consistent long term downward trends are apparent.

Because most commercially important species utilise estuaries during only part of their life cycle, management initiatives need to be directed towards encouraging and maintaining the use of estuaries by the different species, while attempting to ensure that individual fishermen can continue to obtain an appropriate share of the resource. Because of the usually unrestricted movement of fish between estuary and ocean, localised seasonal overexploitation of a resource within a given estuary is possible. However, overexploitation of a total stock of any given species solely as a function of estuarine exploitation is unlikely, provided the species is not totally estuarine dependent as a juvenile or is an estuarine species sensu stricto.

I INTRODUCTION

The Western Australian commercial estuarine fishery is one of the oldest fisheries in the temperate area of the State, traditionally serving pioneering populations who normally settled on the shores of protected navigable waters such as estuaries. Although there was some conflict of interests in estuaries during these early years, professional fishing was acknowledged as one of the most important and proper uses of our estuaries. During later years, however, as population, urban and rural development increased and the economy expanded, the use of Western Australian estuaries became more intense and diverse.

In an attempt to provide the basic information necessary for the responsible management of the various estuarine resources, in particular their fisheries, and thereby help to resolve the inevitable conflict of various user interests, a detailed account of the important events in the development of this commercial fishery is needed. This paper attempts to present such information in the form of an account of the historical development of the fishery, together with an analysis of all available catch and effort data, covering the fishery from its inception until the introduction of the new combined fishermens return in 1975, and the accompanying modified techniq of data analysis and different format of data printout.

II SOURCES OF DATA

A. Historical information

Section III, which deals with the historical development of the commercial estuarine fishery is based, to a large extent, on unpublished information contained in Department of Fisheries and Wildlife files, presently held either at the Departmental Head Office, the State Intermediate Records Repository, or the archives of the Battye Library.

B. Catch and effort data

(i) Review of data collection systems:
Prior to 1941, there was no formal method for the collection of estuarine fish production statistics. Estimates of fish production were variously obtained from a number of related sources.

Fisheries Inspectors' weekly district reports (Form "A") and monthly fish reports (Form"B").

Form "A" reports provided a descriptive account of the location, behaviour, average size and spawning condition of commercial fish caught each day, together with records of air and water temperature.

Form "B" reports provided information on the monthly quantity (lbs landed weight) of each species of fish taken by professional fishermen operating in different areas of the State. Summaries of this information were usually provided in the Annual Report by the Chief Inspector of Fisheries. (Form "B" data became the inspectors' monthly summary of production from his district).

Processing and marketing reports (Form "C") and fish canning reports (Form "G").

These reports were usually provided on a weekly basis by marketers and processors of fish. Reports were also prepared showing the quantities of fish that were caught but not sold through the metropolitan markets (File 222/49 Fisheries General Statistics - 1912).

Returns for fish dispatched by rail (Form "D")

Revenue from railway freight charges for fish transported to the Perth market was used to help estimate the amount of fish taken in the State annually. As all fish taken outside the metropolitan area and marketed in the metropolitan area were transported by rail to the markets for sale, these forms provide reasonably accurate information on the magnitude of these catches. However, as noted above, additional quantities of fish caught around the State were not marketed in the metropolitan area.

Early departmental files These contained catch and effort data other than these data provided by Forms A,B,C,D and G.

In 1941, a fisheries statistics collection system, based on the system used at the time in California was introduced by the then Chief Inspector (= Director) of the Department of Fisheries. In this system the ocean was divided into fishing areas or blocks of 1° latitude by 1° longitude. Four estuaries (Swan-Canning, 9501; Peel-Harvey, 9502; Leschenault, 9503; and Wilson Inlet, 9506) (Figure 1) were also coded as separate fishing blocks. All professional fishermen were required to submit a return each month to the District Inspector. These returns and a monthly summary sheet of production from that district (Form B above) were submitted to Head Office each month by the district Inspector. Data recorded for each block in this manner were the number of each species taken, gear used and hours worked catching the fish. Conversions from numbers to weight were made at Head Office. In 1949, separate monthly returns were required for each of the deep sea, rock lobster and inshore/-estuarine sections of the commercial fishery. Monthly

data collected from the inshore/estuarine component of the fishery were catch (wt) by species, by method, i.e. nets, drop nets, traps and set lines, and the number of men and boats and the days spent fishing (effort was recorded for all methods combined), in each estuary. Several other changes were made to the overall system during the period 1949-1974/75. The initial one was the introduction of a fourth type of return in 1963 to cater for the needs of commercial trawling operations. During 1964, four additional commercial estuaries, Princess Royal Harbour and King George Sound*, 9504; Oyster Harbour, 9505; Irwin Inlet, 9507 and Broke Inlet, 9508 (Figure 1); were added to the existing four, making eight estuaries in all for which the Bureau of Census and Statistics provided detailed monthly summaries of production data. Computer processing of catch and effort data commenced at the Bureau in 1967. Thus although the format of the return had changed over the years since 1947, the basic items of inshore/estuarine data collected over this period have remained essentially unaltered.

In July 1975 (i.e. the commencement of the 1975/76 financial year) a new commercial fisherman's return form was introduced. This single new form catered for all the above four fishing techniques, i.e. deep sea, rock lobster, inshore and estuarine fishing and trawling, and thus superseded the previous system which required separate forms to be completed for each of these techniques. The catch and effort data available from this new system are rather more detailed than previously available as they provide separate catch and effort data for each fishing method used during each month. Thus the catch from, and effort expended using, beach seine and mesh (gill) netting techniques are able to be separated. There is also provision on the form to record in more detail the fishing effort expended each month. For example, in addition to the number of days spent fishing, there is provision for recording the number of hours spent fishing per day.

At the beginning of the 1977/78 financial year, and following the introduction of the conditional licence management regime (Section III), the following eleven additional south coast estuaries were designated as commercial fishing blocks;

*Listed as a commercial estuary, but in reality is a marine embayment.

Name	Block Number	Position of entrance to ocean Lat.	Long.
Hardy Inlet	8501	34°20'S	115°8'E
Parry Inlet	8502	35°1'S	117°10'E
Beaufort Inlet	8503	34°27'S	118°55'E
Wellstead Inlet	8504	34°23'S	119°25'E
Gordon Inlet	8505	34°16'S	119°30'E
Dempster Inlet	8506	34°4'S	119°40'E
Hamersley River	8507	33°58'S	119°55'E
Culham Inlet	8508	33°56'S	120°3'E
Oldfield River	8509	33°53'S	120°47'E
Torradup River	8510	33°52'S	121°1'E
Stokes Inlet	8511	33°51'S	121°8'E

This report is intended to cover the period up to the introduction of the present commercial fisherman's return, i.e. the beginning of the 1975/76 financial year. However, production data in the old format are obviously only available up until the end of the 1974/75 financial year (i.e. June 1975). Thus to complete the data for the 1975 calendar year, the first six months data recorded under the new system had to be reprocessed under the old format.

(ii) Data available for analysis:

Catch:

Pre 1941

Unfortunately much of these early catch data have been either lost or destroyed. However, there are some records remaining on old Departmental files, many of which are presently stored at the State Intermediate Records Repository and the Western Australian State Library Archives.

A proportion of these data were in the form of annual catch of the various species in each estuary and were thus able to be used in this paper. However, much of this information is of limited use as it is in the form of annual catch by species or total catch of all species by district, no distinction being made between fish caught in the ocean or estuary. Nevertheless, for completeness, these data are presented in Tables 2(a)-(d).

1941-1951

Although catch data were submitted via the District Inspector to Head Office each month, the only data which appear to be available today are those from the Swan-Canning, Peel-Harvey and Leschenault estuaries, and Wilson, Irwin and Broke Inlets, which reported annual catch of selected species, and which had apparently been manually tabulated from the monthly file summaries. (Tables 3(a-c), and (f)-(h)).

1952-1963

Monthly catch data for all species is available from each of the above six estuaries throughout this period.

1964-1975

Monthly catch data is available for all species from each of the eight commercially important estuaries. (Tables 3(a)-(h)).

Fishing effort:

Pre 1951

Although fishing effort, in the form of the number of men and boats operating monthly in each estuary, and the hours worked catching the fish (pre 1941-1948) and later (1949-1951), days spent fishing each month were allegedly forwarded to the Department of Fisheries and Wildlife Head Office each month, only intermittent records of the number of men and boats operating annually from each estuary seem to have survived.

1951-1975

While estimates of the numbers of men, boats and days spent fishing were allegedly provided by the fisherman's monthly return system, only the first two provide a reliable available monthly index of effort. In this report the average numbers of men and boats operating monthly was preferred as a measure of fishing effort because it enabled comparisons to be made over a much longer period of time.

A summary of all available annual catch and effort data, together with explanatory notes which aid interpretation are presented in Tables 2 and 3. Additional interpretive guidelines regarding the actual species included under the various common names are provided in Appendix 1.

III HISTORICAL DEVELOPMENT OF THE FISHERIES

A. The early years

The Western Australian coast received many early exploratory visitors, such as Vlamingh in 1697, who named the Swan River (Gentilli 1969). However, official settlement was not made until 1829 (Colbatch 1929). Initial colonisation and settlement of new countries has usually been made on the shores of protected navigable waters, in close proximity to arable fertile land. Thus the shores of the river systems, and to a lesser extent protected marine embayments, have been prime settlement targets. Western Australia was no exception. One of the very first colonies, which was later to become the capital city, was established on the banks of the Swan River, approximately 19 km from its mouth where the new port of Fremantle was subsequently sited.

Although some food supplies were obtained from other established countries (particularly the homeland) new settlers must have depended to a large extent on the natural food resources of their new country, particularly those close at hand. Thus estuarine fish populations were probably amongst the State's first commercially exploited aquatic resources.

It follows therefore that the Swan-Canning river system supported the State's first commercial estuarine fishery which, as will be explained later, was followed in the period up to 1930 by the development of fisheries in the Peel-Harvey, Leschenault, Vasse and Wonnerup estuaries, Princess Royal Harbour, and King George Sound, Oyster Harbour and Wilson Inlet, and later the Blackwood, Broke and Irwin Inlets and finally in the Murchison River and some of the estuarine systems between Albany and Esperance.

During the period from 1829 to approximately 1890, the documentation of the development of the State's estuarine fisheries was very poor, and catch and effort statistics were apparently not recorded. It must be concluded from the documents relating to the post-1890 fishery that the first sixty or so years of the fishery was a rather haphazard affair, with no formal marketing system, catering almost entirely for local demand in the various settlements along the Swan and other similarly located estuarine settlements in other areas of the State.

Indeed, because of the very small State population at the time, the fishery would have been understandably small and largely based in the Swan-Canning system, however with some supplementation from the waters off Fremantle and in Cockburn Sound.

B. The late ninteenth century

The period of the fishery from the late 1880's until approximately 1920, was reasonably well documented but good catch-effort records are lacking.

During the late 1880's and early 1890's, considerable quantities of processed fish were being imported into the colony (Saville- Kent 1893-4) (Table 1). It can only be assumed that during this period the continued operation of canning factories (the first of which opened in 1876) in the Mandurah district and attempts at curing local fish were aimed at cutting the amount of imported fish products being consumed in the colony (as well as obviously providing a profit for the various operators). Sea mullet, yelloweye mullet and Perth herring were the major species processed in this manner. Aparently sea mullet produced the best canned product. Although Perth herring smoked well and was very popular, the numerous fine bones characteristic of the species lessened the appeal of this smoked product.

It is of interest that the mud oyster (*Ostrea angasi*) populations in the embayment and estuarine waters of the Albany district had already been overfished during this early stage of the State's settlement. Restricted populations still exist in Oyster Harbour and Irwin Inlet today. However they are only fished to a very limited extent commercially, and are only occasionally taken by those amateurs prepared to dive.

The paucity of the freshwater component of the fish fauna of the estuarine systems, particularly those species of economic value, was quickly recognised by members of the early community. A number of attempts were made to rectify the situation, including the building of a fish hatchery on the Preston River in order to stock suitable river systems with trout and redfin perch; and the introduction of Murray cod, Murray perch and silver eel from Victoria into the upper reaches of the Swan-Avon River system. These types of introductions were common during these early years of the colony (Saville-Kent 1893-4). As a legacy of these early attempts at fish introduction, today's remaining fresh streams and rivers of the south-west of the State support breeding populations of redfin perch, and rainbow and brown trout. However their overall breeding success has been insufficient to enable the cessation of the re-stocking of these freshwater areas with trout from the State's Pemberton Hatchery.

From available reports (such as Thompson 1898) it was also clear that fisheries developed in estuaries adjacent to other outlying population centres such as Albany, Bunbury, Busselton and Mandurah during the early 1890's. The Peel-Harvey estuary had been supplying fish to the town of Mandurah for some time evidenced by the fact that as early as the late 1840's concern was being expressed about overexploitation of the stocks and certain closed water regulations were introduced in an attempt to curb this unsatisfactory situation.

Fishermen in the Peel-Harvey estuary were frustrated because of the lack of rail communication with the metropolitan area. Fish caught commercially in the estuary either had

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to be carted overland to the Perth-Bunbury rail-link and then to Perth by train, or to Fremantle by sea. Factors such as the extremely hot summer conditions, the shallow estuary sand bar, periods of rough weather and poor quality of available cooling facilities made regular transportation to the metropolitan area an economic impossibility. However despite all these problems some progress towards a solution was being made because a cool storage facility capable of taking 18t of fish per week was established on the banks of the Murray River.

Two canneries were processing fish from the Peel-Harvey estuary. This relieved the marketing problem to some extent, because it helped prevent unnecessary wastage of fish and provided a product that could be periodically transported to the metropolis without the fear of decomposition enroute.

One of the earliest documented instances of user conflict in these estuarine systems was between the commercial fishermen and aborigines who used a fish trap or "Mungah" on the Serpentine River which flows into the Peel-Harvey estuary (Figure 1). Commercial fishermen claimed that the continual operation of the trap had adversely affected their catches in the estuary.

Other estuaries in the south-west had also begun producing quantities of fish. However, since they were remote from the metropolitan area, their full potential was clearly not realised. Nevertheless, Princess Royal Harbour and King George Sound, Oyster Harbour and Wilson Inlet produced good quantities of fish for the Albany district, the adjacent goldfields, and for ships which visited the port of Albany.

An estuarine fishery had also developed in Leschenault estuary (Bunbury). A number of closed water areas were declared in this estuarine system to help conserve the fish stocks of the area.

In the Busselton district, the Vasse-Wonnerup estuary contributed only a very small amount of fish to the commercial catch from the lower west coast. The majority of the catch from this district was taken from Geographe Bay, an adjacent marine embayment.

The Bunbury district had a distinct advantage over the nearby Mandurah district in that it was linked to Perth directly by rail. Fishermen thus had the extra convenience of being able to transport their catch in refrigerated railcars for sale in the metropolitan area.

Farther north at this time, however, doubts were being registered regarding the ultimate capability of the Swan-Canning estuarine system to be a major producer of commercial fish. Both the intense conflicts of usage

which already existed between commercial and amateur (domestic) fishermen and other recreational users, and the disturbing influence on the system of activities associated with the busy sea port of Fremantle were reasons forwarded in support of this view. There was apparently a body of opinion which considered that the estuarine fish and crustacea should be left for the more sedentary inhabitants of the city to exploit during their leisure hours. Thus although a number of commercial estuarine fisheries had been established in the State by about the beginning of the 20th century, they were not without their problems. The more significant of these are summarised below:

(i) Transportation of produce from outlying areas to the metropolitan area was difficult due to:-

(a) inadequate modes of transport;

(b) inadequate cool storage in transit;

(c) transportation distances were great;

(d) since fish were not cleaned prior to transportation, the quality of fish landed in Perth was often poor.

(ii) Once the fish reached the metropolitan area there were no central marketing facilities, and those facilities which were available were inadequate in many ways. For example there was no control over supply, and consequently there was wastage when fish were plentiful, and when fish were in short supply, they were expensive to buy.

(iii) The freight rates from country areas were excessive, making the fish relatively expensive once it was landed in the metropolitan area; with the inevitable result that once the wholesalers and retailers added their profit margin, only the wealthy class of consumer could afford to buy the product. Thus the demand for and importation of the cheaper dried, salted, pickled and preserved fish continued to rise (Table 1).

(iv) User conflict was developing rapidly in the estuarine systems adjacent to the largest population centres of the State.

Further there was no statistical system for the collection of the catch and effort data essential as a basis for both biological and economic management of the fishery.

C. Years following the proclamation of the first Fisheries Act

In 1899 the first Fisheries Act was proclaimed. Although the industry had been operating for some time, it only then appears to have achieved sufficient importance for the

Government to gather together all existing fisheries-related regulations (initially passed under other Acts) and have them included under this separate Act.

During this early period of the fishery, when Greeks and Italians far outnumbered the British members of the fishing industry, there was great concern expressed that the use of seine nets in many of the estuaries and more particularly the use of hauled prawn seine nets in the Canning and "dredged" or dragged nets in the Melville Water region of the Swan was destroying many juvenile fish (Gale 1900). As a consequence a number of small estuaries were completely closed to netting. It was also advocated that prawners should only be allowed to use hand prawn nets but be permitted to fish in the whole Swan-Canning River system, rather than just the Canning. However, restrictions on prawn nets were not introduced until 1916 when the Government announced that they were all to be hand hauled and limited to 9 feet in length (Aldrich 1917).

Area closures, and a number of gear related regulations were being more widely introduced into estuarine fisheries during the early 1900's, particularly that of the Peel-Harvey system (Gale 1902). With increases in the number of regulations came the need for increased levels of surveillance by the various District Inspectors, in an attempt to halt the increasing trend in breaches of these regulations (Gale 1908). It was encouraging to note that at this time increases in the catches from the Peel-Harvey system were attributed to the closure of the Murray and Serpentine Rivers and the estuary channel to netting (Gale 1908).

It had become clear also that natural environmental conditions in the different estuarine systems fluctuated markedly from year to year, particularly the extent of the winter freshwater flush (Gale 1904, 1906, 1908, 1910). This was also true of the condition of the sand bars at the estuary mouths, notably those of the Peel-Harvey and Leschenault systems (Gale 1902, 1904). These factors, together with the variable breeding success of the different species from year to year, affected recruitment of these species into the estuarine system and consequently catches of these species fluctuated accordingly from year to year (Gale 1901, 1902).

Fluctuating catches, together with the still unsatisfactory transportation and marketing arrangements continued to make the supply of estuarine fish to metropolitan consumers uncertain and expensive (Gale 1902).

During the early 20th century, the activities of amateur fishermen were very intense, particularly in the Peel-Harvey estuary and the Swan-Canning estuary where in some years domestic net fishermen caught as many prawns annually as professionals (Aldrich 1917). Amateur fishing activity was also intense in the Leschenault estuary which at this time was completely closed to all forms of netting (Gale, 1904, 1906, 1908). All fish taken commercially from this

estuary were handlined, and sold in nearby Bunbury before the fishermen from the ocean areas arrived into port. This practice created considerable conflict between these two groups of fishermen in the area (Gale 1910).

During these early years of the 20th century three canneries operated in the Mandurah district (Gale 1906), making use of summer catches that could not be marketed and would otherwise have been wasted. However, the high cost of this operation, in part due to the heavy import duty on tin plate and solder, meant that the product was very expensive.

During 1907 a central marketing system was finally established in both Perth and Fremantle (Gale 1908). This resolved many of the earlier marketing problems and encouraged more fish to be forwarded from outlying centres. However, predictably it adversely affected the role of the metropolitan fish hawkers.

Despite earlier problems with the relatively high cost of tin plate and solder, the three Mandurah canneries continued to operate into the 1920's (Aldrich 1922) and produced, as well as the canned product, small quantities of smoked fish (Aldrich 1917).

By the late 1920's and early 1930's commercial fish catches from the estuaries of south-Western Australia had begun to increase (Tables 2 and 3). Outlying centres such as King George Sound and Princess Royal Harbour, Oyster Harbour and Wilson Inlet became the major commercially fished estuaries of the south coast. However, the cool storage process during rail transportation was still too inefficient to guarantee that fish arriving from Albany at the Perth metropolitan markets were in good condition. Added to this, freight was charged on the weight of the fish,the ice and the box, not just the fish. This severely reduced profit margins for fishermen and discouraged them from transporting fish to the metropolitan markets (Aldrich 1927). Thus much of the fish caught in these southern estuaries continued to be consumed by the local population, by towns people on the Great Southern Railway and in the adjacent goldfields (Aldrich 1929a).

Good catches of fish, principally black bream, yelloweye mullet and sea mullet were beginning to be taken from the estuaries between Albany and Esperance. The fish was transported from these estuaries to the Perth-Albany rail link by truck, and then by rail to the markets in Perth and Fremantle. However a number of these fish marketed during the summer were condemned. Thus fishermen were advised not to send fish from the estuaries east of Albany to metropolitan markets during the summer months (Aldrich 1928). Those men who fished in the more westerly located south-coast estuaries, such as the Blackwood River estuary and Broke and Irwin Inlets were similarly disadvantaged by inadequate storage and transport facilities.

Because the entrances of most of the estuaries east of Albany were closed temporarily or permanently by sand bars, it was soon clear that intense fishing while the bars were closed rapidly depleted fish stocks within these estuaries. Thus netting in these eastern estuaries was prohibited (Aldrich 1929b).

Although the marketing system had improved in the metropolitan area, there was still a major problem in that there were no cool storage facilities at these markets. The cool storage that was available was privately owned and not located on the market sites.

As the community expanded economically, the contribution of estuarine fisheries to the total commercial fish catch of the State decreased, having to compete with the small but rapidly growing sectors of the fishing industry which were operating in the inshore-marine environment, i.e. rock lobster and deep sea fishing (snapper and jewfish) industries. However, estuaries still produced good quantities of fish and crustaceans principally for the local fresh fish market. In fact the majority of the crabs and prawns consumed by the people of Western Australia still came from the estuaries of the temperate regions of the State, particularly the Swan-Avon and the Peel-Harvey, and to a lesser extent from Leschenault. Throughout the period between 1920 and 1930, annual State prawn catches ranged from a low 30 800 kg in 1923 to a high of 65 800 kg in 1928, while catches of crabs varied from 10 400 kg in 1923 to 22 300 kg in 1926 (Aldrich 1921 to 1931).

From the 1930's onward, the estuarine fishery progressed through a period of unchecked but relatively slow expansion, mostly in terms of men employed in the industry, but also in terms of actual total catch (Tables 2 and 3). However factors such as the relatively small population of the State; the great distances involved and difficulties of communication; the availability of ample agriculturally derived protein; and later the advent of World War II from 1939-1945, all continued to constrain the rate of expansion of this fishery.

During the late 1940's and early 1950's the development of a lucrative and expanding export market for rock lobsters (Sheard 1962) encouraged increasing numbers of fishermen to participate in the rock lobster (then known as "crayfish") industry in preference to the wet fishery. Those fishermen employed in the wet fishery found that their products could not compete on the open export market, nor locally with the relatively cheaper and more convenient frozen imported product. Apart from a further attempt to establish fisheries in the estuaries east of Albany (Table 4), and a further attempt at canning fish at Mandurah in 1956, very little effort was made to undertake new initiatives in estuarine fisheries.

Thus particularly during the 1960's, wet fishermen, many of whom were part-time, were receiving a decreasing income from fishing. Inducement for fishermen to remain in the wet fishery was further eroded firstly by the establishment of an export market for Shark Bay-Exmouth Gulf prawns in 1962 (Slack-Smith, 1978) and later by additional local and export markets for scallops and abalone respectively.

Marketing difficulties which had been experienced throughout the early history of the wet fish industry continued. The channels of distribution, particularly from centres outside the metropolitan area remained long and at best only marginally profitable. The quality of the perishable product was often badly affected as a result of being transported on outmoded rail facilities. Also the arrival of the product in Perth more often than not did not coincide with market times.

These forementioned problems were compounded by the fact that fishermen often sold to the highest bidder, showing only limited allegiance to the one buyer. Buyers ranged from metropolitan market agents, co-operatives, wholesalers, canning or other processing companies, fish shop proprietors and the general public.

Once in the hands of processors/wholesalers, the product from estuaries was mostly too small (because a larger proportion of them were juveniles; see Section V A(i)) to be filletted, frozen and packed economically to compete with the frozen imported product. Retailing whole fresh fish was also difficult because the consumer preferred the cheaper more convenient already processed frozen product that was being imported.

Although high quality species such as whiting and cobbler were always in demand as food fish, there were insufficient quantities of these species available to support the large number of estuarine fishermen operating in the State. Thus many fishermen were forced to catch species that could be sold as rock lobster bait, noting that it was often very difficult to dispose of many of these bait species such as mullet or Perth herring at an economic price.

Because of the nature of the estuarine fish resource (see Section V C) and the rapidly increasing demands of other users of estuarine areas, e.g. recreational fishermen (Lenanton, 1979), boaters etc, the potential for growth of the commercial fishery was clearly limited.

Being aware of these and other similar problems in the inshore- marine wet fishery, the Government commissioned, in 1969, a firm of consultants to investigate the wholesale and retail marketing of all wet fish in Western Australia. As a result of Steering Committee guidance the consultants were eventually only required to undertake a "pilot study". Their resultant report to Government (Scott 1969) generally outlined the situation reported above.

One of their most important conclusions from the pilot study was:-

"There are more professional net fishermen than the industry can or is likely to be able to economically support. A large proportion of these fishermen are estuarine fishermen".

Following on from this conclusion, it was recommended that government should:-

"Do what it can to reduce the numbers of fishermen, particularly estuarine fishermen in the industry and only issue new professional fishing licenses where there is a strong economic case for doing so".

The factors which are believed to have contributed to this "oversupply" of estuarine fishermen have been discussed above and were mentioned briefly in the Scott report. However, irrespective of the precise reasons for the development of this situation, the end result was that there were too many professional estuarine fishermen, many of whom were part-time, for each to receive an economical return from his catch.

The Government accepted the above recommendation and proceeded to try to reduce the numbers of professional fishermen operating in the State's estuarine fisheries. However while acknowledging the existence of too many estuarine fishermen, the Government firmly believe that professional fishing is a proper use of the estuarine fish resource. Their view is best summarised in two extracts from State of the Fisheries of Western Australia 1977-78 (Department of Fisheries and Wildlife 1978).

"The estuaries are being used to an increasing degree by the community for many forms of recreation including water skiing, boating, and amateur fishing, crabbing and prawning. These forms of activity are, of course, a proper usage of the estuarine resource, but each increased activity has the potential to affect adversely the catch of the professional fisherman. Many of these fishermen have been actively engaged in providing fresh fish for the Perth markets over decades of time, and planned usages of the estuaries must take into account the needs of the professional fishermen even though their numbers are small compared with that of the touring and sporting public".

"In considering the use of a fishery resource in the estuaries it is necessary to note that both professional and amateur fishermen are operating in a responsible manner. The professional is providing fresh fish for the public and in doing so he is maximising his income, whilst the amateur is taking fish for himself and his friends and at the same time maximising his enjoyment".

Thus, since 1969, the Department of Fisheries and Wildlife has endeavoured to reduce the number of fishermen fishing in estuaries to a level at which individual fishermen are able to achieve a worthwhile economic return from fishing alone. This is being achieved by:-

(i) Not issuing any new estuarine fishing licenses.

(ii) Not renewing estuarine fishing licenses that have expired, either as a result of the death of the fisherman, or the unwillingness of the fisherman to continue in the fishery.

Although in terms of commercial production this document only covers the development of the fishery up to and including 1975 (see Section I, II B), it is important that more recent developments in the fishery involving some important policy decisions be reported.

For Departmental management purposes, the estuarine fisheries of temperate Western Australia have been divided into the following distinct fisheries, termed conditional license estuarine fisheries.

	Name	Number of Fishing Units Operating, 1979
1.	Hardy Inlet Estuarine Fishery	4
2.	Leschenault Estuarine Fishery	18
3.	Mandurah Estuarine Fishery	45
4.	Swan-Canning Estuarine Fishery	32
5.	South Coast Estuarine Fishery	72

The first four of these, together with the appropriate instructions to licensing officers (rules) were declared by Ministerial approval during 1976, although at that stage, 1 and 2 above were combined, and it was not until prior to their eventual gazettal that the two fisheries were separated and considered as independent entities.

During 1978, the south coast fishery was added to the initial group of four fisheries. The initial four of the above five fisheries were then gazetted together on February 23, 1979, including instructions to licensing officers (rules) together with a schedule of the names and class of fishermen, and the registration numbers of the authorised fishing vessels, which comprise each fishing unit.

Except for a schedule containing a description of each fishing unit the south coast fishery was gazetted on February 8, 1980. The number of units in the south coast fishery was, at the time of publication, fixed. The number of units operating in the other four fisheries are subject to review from time to time.

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IV FISHING GEAR AND TECHNIQUES

The design and use of present day fishing gear varies considerably from estuary to estuary. Historically these differences have developed in response to circumstances related to the exploitation of the various target species in physically different estuarine systems. It is the intention here to report in general terms the various types of gear and techniques used by professional and amateur estuarine fishermen, noting that although the basic fishing techniques have changed little over the years, the specific gear dimensions such as length and mesh size have changed and are likely to continue to change in future years.

A. Professional fishermen.

Setting and hauling gill nets are the two main methods used by commercial fishermen in the estuaries of Western Australia (Figure 2). Except when fishing for cobbler and crabs, fishermen practising these two techniques mostly use the same basic nets. The two methods differ, however, in that setting involves fishermen leaving gill nets unattended overnight in areas where fish are likely to be caught. In contrast, hauling is principally a daytime technique involving actual searching for and hauling schools of known species of fish. Historically there are four methods of hauling fish. "Circling" is the most commonly used method (Figure 2). After a school of fish is detected over clear hauling bottom, the net is laid around the school. One end is attached to the boat while the other end of the net is slowly hauled into the boat. As the circle gets smaller, the fish tend to panic and are meshed in the remaining net before being hauled into the dinghy. The other three methods involve frightening fish that are lying over bottom that cannot be hauled conventionally, away from such areas and into an appropriately positioned net where they mesh. The first of these, "bull ringing" involves completely circling the area with net; "half-mooning" involves surrounding the area where the fish are located with a semi-circular shot from the shore, while "bashing" involves laying the net in close proximity to the fish in any configuration except the two mentioned above. The most common method of frightening the fish is to strike the surface of the water with an oar.

Some hauling is still done from small netting rowboats. However, in most hauling and setting operations, gear is laid and retrieved from open motorised netting dinghies, which are normally approximately 5 m in length. In earlier days inboard motors were preferred to outboards because they ran more quietly. However, in recent years outboards are increasingly being used because the more modern motors are more powerful and are now built to run more quietly.

In the lower west coast estuaries (Figure 1) sea mullet, yelloweye mullet, cobbler, Perth (boney) herring, whiting and garfish are the main target species, with quantities of most other species resulting from incidential catches when fishing for target species. Basic haul and set nets are often in excess of 500 m in length. The minimum stretched

mesh size for these nets in the Swan-Canning is 57 (54 mm for yelloweye mullet only) and 63 mm respectively. In addition there is a haul net called a "sunk net" which can only be used in Melville water during certain times of the year, a feature related to the periods of peak abundance of the species being sought. This net has, amongst other design restrictions, 76 mm wings and a 57 mm bunt. In Leschenault Inlet and the Peel-Harvey estuary, the minimum mesh size for basic (haul/set) nets is 51 and 47 mm respectively. When hauling for whiting, cobbler or garfish a shorter smaller meshed "bunt" or "pocket", with a mesh size of 44, 44 and 28 mm respectively is attached to one end of one of the larger basic nets (Figure 2). In the process of hauling all fish are worked down into the terminal bunt allowing all legal sized fish to be retained, while undersize fish escape through the mesh of the bunt. In the case of cobbler, which tangle very easily in lighter ply nets, the bunt is made of extra heavy monofilament or multifilament twine, which acts as a "seive", allowing the undersized fish to escape unharmed (Figure 2). Bunts or pockets are not usually used when hauling for the mullet species.

As mentioned above, when setting for all species except cobbler most of the same basic nets are used. Set nets for cobbler however, have a minimum mesh size of 76 mm, and a restricted net depth.

Crabs can be taken in all commercial west coast estuaries by means of drop nets, hand scoop nets and set nets (Figure 2). In the Swan-Canning set nets must have a minimum mesh size of 63 mm, and are subjected to a restricted overall length. However, the use of special larger meshed crab set nets in estuaries other than the Swan is unregulated. Cobbler and crabs are also caught incidentally in basic haul and set nets when they are used to catch other species such as mullet. However, when caught in this gear, both species are likely to be under the legal minimum size. Thus fishermen have learnt to avoid such problems by only using the appropriate gear in areas inhabited principally by legal sized individuals of these two species.

In those estuaries situated from Albany westward on the south coast, sea mullet, yelloweye mullet, cobbler, whiting and garfish are still the major target species, with Australian herring and flathead also sought. Cobbler set nets are the same as those used on the west coast. In Wilson Inlet garfish are able to be taken on a seasonal basis in 44 mm mesh net of special design. In Irwin Inlet, a black bream set net must have a minimum mesh size of not less than 89 mm. All other set nets used in Irwin Inlet, Wilson Inlet, Oyster Harbour and Princess Royal Harbour have a minimum mesh size of 57 mm. All nets used in Broke Inlet must have a minimum mesh size of 63 mm.

In commercial estuaries east of Albany, black bream, sea and yelloweye mullet are the main target species. Gear restrictions apply only in the Bremer and Pallinup estuarine systems where there is a minimum mesh size of 76 mm; and in Bandy Creek ($33^{o}50'$ S latitude, $121^{o}55'$ E longitude) where mesh or set nets must have a minimum mesh size of 89 mm, and a "seine

net" must have minimum mesh sizes in the wings and bunt of 76 and 25 mm respectively. Length restrictions also apply to both these Bandy Creek nets.

In all commercial estuaries prawns can be caught legally as an incidental catch in gear used to catch other species. Usually, however they are caught by a hand trawl net with maximum length of 3 m, or a hand dip net with 61 cm maximum diameter. A hand operated dredge net with 120 cm maximum opening width and a beam tide trawl with a maximum width of 4 m are legal only when used in certain areas of the Peel-Harvey estuarine system (Figure 2). All the above prawn nets must be constructed with net of not less than 16 mm stretched mesh.

Fish traps (Figure 2) are able to be used commercially in most estuaries. However this method is not commonly used, except to catch cobbler in the Swan-Canning and to some extent in the Peel-Harvey estuary, and to catch leatherjackets in Princess Royal Harbour.

Although a net of a certain miminum mesh size is specified for each major species, under certain circumstances fishermen do deviate away from this minimum in order to maximise the efficiency of their operation and the quality of the product. One strategy which is widely practised by estuarine fishermen involves the use of nets with slightly larger mesh sizes. For example in the cool winter months fish tend to be more sluggish and greater numbers of smaller ones are caught in the nets of legal minimum mesh size. To offset this, and thus reduce the chance of catching more undersize fish, fishermen tend to use slightly larger mesh sizes during these months. However other situations demand the use of nets with slightly smaller mesh sizes. For example, during the summer and autumn of 1981, Peel-Harvey yelloweye mullet were apparently in very poor condition. In order to retain all legal sized fish, a net with slightly smaller mesh size was used. However, normally during that period of the year larger yelloweye mullet are abundant, and in very good condition. Under these circumstances the use of haul nets with slightly smaller mesh sizes will result in all legal sized fish being "nosed" rather than being conventially meshed. Thus rather than having to be individually unmeshed, fish can be shaken out of the nets "en masse". The quality of the marketed product is thus improved by reducing the time taken to catch and box the fish during these hot summer months.

A third basic netting method which was more popular during the early history of the fishery is beach seining (Figure 2). These nets are often up to 1000 m in length. The main section of the net (equivalent to the wings) is normally constructed of 51 mm stretched mesh, with 25-31 mm mesh bunt situated either terminally or more commonly in the middle of the net between two wings. The net is laid in a semicircle from the shore and hauled back onto the beach; or it can be laid over offshore banks and hauled in from an anchored dinghy. This method is still used in south coast estuarine systems, notably Wilson Inlet, Oyster Harbour and Princess Royal Harbour. However its

successful operation is dependent on the availability of a smooth sandy hauling bottom. Such conditions are increasingly difficult to locate in an estuarine environment plagued by abundant macroalgae which is proliferating as a direct result of increased levels of nutrients derived mainly from agricultural practices in catchment areas.

Because they are less visible to fish, monofilament nets tend to produce higher catch rates than multifilament nets. Thus virtually all haul and set nets used in the present day fisheries are made of monofilament twine. The replacement of multi with monofilament nets has been gradual from the time of their first introduction into the Peel-Harvey fishery during the late 1960's. However, the visibility of nets to fish is not a factor which affects the catch rates of beach seine nets. Thus, beach seine nets are still constructed from multifilament twine, particularly because of the added advantage that substantial lengths of this type of netting can be handled more easily during netting operations, and can be stacked more efficiently in the netting dinghy.

B. Amateur fishermen

Set and haul nets are also used by licensed amateur fishermen Both net types have length restrictions of only 60 m; and the former a minimum mesh size of 57 mm, while the latter is 63 mm, and is not to be constructed with a "pocket" or "bunt". Amateurs are also permitted to use fish traps in certain areas in most estuaries, and can catch crabs by means of drop nets or hand scoop nets, and prawns by means of a hand held trawl net and hand dip net. Dimensions and mesh size for crab and prawn nets are the same for both amateurs and professionals.

V CATCH AND EFFORT DATA

A. Interpretation of catch and effort data

The amount of fishing effort expended each month by a given estuarine fishing unit varies greatly and in practice ranges in some cases from 1 to 31 days per month. Under these circumstances, the time spent fishing would clearly be the most accurate index of effort. Although such data are available over some of the past years for the fisheries of several of our estuaries, they are not available continuously throughout the history of the entire fishery, and thus were not able to be used to explore the long term trends in these fisheries. The only consistently available unit of effort for our estuarine fisheries is the number of men and boats, which would seem to represent an extremely gross estimate. However, analysis of some recent catch and effort data from the Swan-Canning and Peel-Harvey estuaries (Lenanton et al. ms. submitted) has shown that the number of days spent fishing is directly proportional to the number of boats fishing each month. Therefore, at least for the above two estuaries, the magnitude of catches is equally well related to the time spent fishing (effective effort) and the number of boats (measured effort).

It is clear from the data listed in Table 3 (a)-(h) that catches fluctuate considerably between species, between estuaries and from year to year, and that these fluctuations are apparently not entirely related to different levels of expended effort. Although it may be desirable, it is not possible within the scope of this paper to discuss these catch trends for every species taken commercially from each of the eight comercial estuaries. However, it is important to identify and understand in relatively general terms the following most important factors which contribute to these catch fluctuations:-

(i) The life history strategies of the different species in the areas able to be fished;

(ii) The manner in which fishermen harvest these stocks i.e. the fishing methods;

(iii) The market demand for a given species;

(iv) The accuracy of the recorded catch and effort statistics.

(i) *Life history strategies*

Fish adopt a number of different life history strategies in order to utilise the south-Western Australian estuarine environment (Lenanton 1974a, 1977, 1978; Chubb et al. 1979).

There are basically three strategies involved:-

(1) Some fish are able to undergo the whole of their life cycle within the estuarine environment. Included in this group are black bream and yellowtail perch (yellowtail trumpeter). Also included in this group are cobbler, flathead, flounder and whitebait which, provided estuarine conditions are suitable, can undergo their entire life cycle in the estuary in a similar way as they would in the inshore-marine environment. With the exception of whitebait all stages of the life cycle of the above species are exposed to commercial fishing operations in estuaries.

(2) Some fish use the estuary predominantly as a nursery area. This group includes mostly essentially marine fish such as the mullets, whitings, silver bream (tarwhine), and tailor. It is principally the immature component of populations of these species which are subjected to commercial exploitation in our estuaries.

(3) The third category of fish use the estuary as a feeding ground at some stage after their first year of life, i.e. for maturing and mature individuals. Many species such as the leatherjackets and the red gurnard which are only caught intermittently or are represented in the commercial estuarine catches in very small numbers and the "marine stragglers" of the Swan Avon River system (Chubb et al. 1979), adopt this life history strategy.

There is a fourth group comprising freshwater species. However, this group is represented by only a few species none of which contributes to the estuarine commercial fish catch (Lenanton 1977, 1978).

The abundance of each species will depend to a large degree on how successfully it copes with both natural environmental variables (hydrological, topographical and biological), and the man-made environmental perturbations to which it is subjected. These will be examined in the following sections.

Environmental factors

Natural environmental factors such as salinity, temperature, dissolved oxygen, turbidity, available food and shelter all influence the manner in which the different species utilise the estuaries (Lenanton, 1977, 1978) and each cannot be thought of as operating entirely independently of the other. However, the single factor which clearly has the most influence is salinity. The manner in which salinity, and indeed the other parameters listed above, fluctuates seasonally in Western Australian estuaries is well documented (Hodgkin 1974; Lenanton 1974b, 1977, 1978). Thus, species which are able to cope with both winter periods of reduced salinity, and the prolonged periods of exposure to the summer hypersaline conditions (i.e. the more euryhaline species), and thus are able to be present in the estuarine environment throughout the year, will, all other things equal, contribute more towards the annual commercial estuarine catch, than species that can only cope with a very narrow range of either seawater or freshwater salinities (stenohaline species).

The monthly catch rates of four commercial species of fish from the permanently open Peel-Harvey estuary (Figure 3) serve to illustrate this point. As noted above the majority of species which adopt the third life history strategy are to a greater or lesser degree stenohaline. Thus, they are most commonly present and caught in the estuary only when the salinities are approximately equal to seawater salinities, i.e. during the summer months. Therefore, the annual catches of species such as sea garfish are generally relatively low (Table 3, Figure 3). Significant estuarine catches are more likely to be of those species which adopt the first or second strategy above, which is indeed the case. Clearly, the species which adopt the first strategy, by definition, could be expected to be caught right through the year. Good examples of this are provided by species such as Perth herring (Table 3, Figure 3). The ability to cope with the freshwater flush of the winter months varies markedly between species which adopt the second strategy. Some such as sea mullet are clearly able to cope better, being caught consistently right throughout the year in many of the State's estuaries (Figure 3). Other species such as tailor, apparently have some trouble coping with excessive periods of low salinity, with the result that winter catches of these species do

tend to fall away, relative to other more euryhaline species (Figure 3).

It should be noted that year-round catches of species such as sea mullet may occasionally be taken from the normally closed estuarine systems as a result of their being trapped in the estuary at times when a sand bar forms, blocking the entrance of the estuary to the ocean.

To further illustrate the points made above, knowledge of the biology of each species has been used to identify the life history strategy which each species adopts, and to relate this to the order of magnitude of the annual commercial catch of each species (Table 5).

Topographical variables

The most important topographical variable is the nature of the entrance of the estuary to the ocean. South Western Australian estuaries can be grouped arbitrarily into permanently open, seasonally closed, normally and permanently closed systems (Lenanton 1974a, 1974b; Hodgkin and Lenanton 1981). Clearly, any closure of an estuarine system has the potential to affect greatly the recruitment of fishes which adopt strategy two and three (Table 5). The less frequently the estuary opens to the ocean, the fewer the species that are found in the estuary, or simplistically the lower the species diversity (Lenanton 1974a; Hodgkin and Lenanton 1981). Comparisons of the number of species of fish and commercially important crustaceans recorded from the different categories of estuarine systems of temperate Western Australia (Table 6) serve to illustrate this point.

Sea and yelloweye mullet are two of the most important fishes taken commercially from many of the more eastern south coast estuaries which are normally closed. Often these two species are only available if there is substantial rainfall to provide sufficient catchment runoff to generate an opening of the estuary to the ocean, thus allowing recruitment of these species from the ocean into the estuary. Then the salinity of the estuary must remain sufficiently low for long enough to allow the recruits to grow to a marketable size.

The long term closure of estuary entrances by sand bars can also have a marked effect on the truly estuarine species such as black bream. During long dry periods, black bream become restricted to the upstream riverine pools, because salinities of the lower estuary of some systems are often too high for the survival of any species of fish. Heavy sustained catchment runoff can result in these bream colonising the lower estuary in great numbers (presumably aided by recruitment of juveniles through successful reproduction); and as was

the case with mullet, if the hydrological conditions of the lower estuary remain favourable for long enough, fish are able to grow to marketable size, and thus are worthy of exploitation.

Human interference

Perturbations generated by human activities can have a more subtle effect on fish species and thus can be much more difficult to detect.

One of the most common disturbances is the relatively frequent occurrence of increased levels of suspended solids in estuaries, mostly as a result of catchment clearing, or dredging in the estuarine systems. The effects of suspended solids on fish and fisheries has been extensively reviewed (Wilber 1971; Moore 1977) and include reports of a wide range of effects on fish reproduction, metabolism and behaviour. This form of disturbance has also been discussed in the context of fishes of Western Australian estuaries by Lenanton (1974b, 1978).

Possibly the most significant effect in terms of estuarine fish catches, is the manner in which such disturbances can influence fish distribution. For example in the Swan-Canning* River system, relatively high concentrations of suspended solids, particularly during periods of winter flushing, could conceivably force fish out of commercial fishing areas such as Perth and Melville waters into more downstream areas such as Mosman Bay and Blackwall Reach which are closed to commercial fishing.

Although only of recent occurrence in Western Australia, it is important to note that the input of nutrients from surrounding agricultural land into the Peel-Harvey estuary, has substantially increased the biomass, first of macroalgae and later of phytoplankton (Hodgkin et al. 1981; McComb et al. 1981). It has been demonstrated that these increases in algal biomass have been respectively beneficial to commercial fish catches from this estuary, (Lenanton et al. in press), and detrimental to commercially important fish species (Potter et al. 1983).

It is also as well to note here that chemical pollutants, such as heavy metals and pesticides, can also indirectly or directly affect the estuarine fish stocks and thus commercial fish catches. The mechanisms, and examples of problems resulting from such pollution are reviewed by Johnston (1976). In this context it is worthwhole noting that the available evidence (Marks et al. 1980) showed that the muscle tissue of fish from the Swan-Avon, Western Australia's most heavily utilised river system, was not seriously contaminated by heavy metals.

* Swan-Canning = Swan Avon

It should also be noted that physical disturbances created by other users of the estuaries, such as boaters and water skiers, can also influence the estuarine environment (Zieman, 1976), its fish populations (Lenanton 1974b), including eggs and larval stages (Morgan et al. 1976) and thus ultimately catches.

(ii) *Fishing methods*

There can be considerable variation in the estuarine areas fished, relative to the areas where the commercially important fish are distributed. For example, the lower portions (approximately equivalent to the channel to the ocean) of both the Swan-Canning and Wilson Inlet systems are completely closed to professional fishing (Figure 1). It is in these areas that a good proportion of the estuarine stocks of a number of important commercial species occur, and it is the fish in these areas that are the sole domain of the amateur angler. Some of the more important species include mulloway, flathead, flounder in the Swan-Canning estuary, and King George whiting and Australian herring in Wilson Inlet. Thus the magnitude of the commercial catch in these estuaries depends greatly on the distribution of the fish in relation to fishing effort. However, seasonal closures of whole estuaries also clearly affect the magnitude of the commercial catches from those estuaries. For example for many of the years for which this document presents catch data both Irwin and Broke Inlets were subjected respectively to nine and between five and ten month closures. This needs to be taken into consideration when making comparisons between the catches from different estuaries.

Varying seasonal and annual catchability of the different species can also contribute to fluctuations in catch rate and thus catches within one estuary, and between estuaries. From research in the Blackwood River estuary (Lenanton 1977) it was concluded that for a given sampling team using the same units of gear in a similar manner throughout a given time period, i.e. a year, the catchability of an individual seine caught species varied both with respect to sampling location within the estuary, and seasonally at any sampling location within the estuarine system; and the catchability of gill net-caught species varied seasonally within the estuary, but probably not between locations at any selected sampling time.

It is appropriate to consider the gill net findings in the context of all commercial estuarine fisheries which use the basic techniques of hauling and setting gill nets. Variables such as environmental conditions, gear design and fishing methods need to be considered. Over the years, there have been similar seasonal and annual trends in gear design and fishery methods in the various estuarine fisheries. Thus catchability of species within these estuaries could be expected to have reflected these trends. However there clearly can be dissimilar seasonal and annual trends in environmental

conditions within and between estuaries, which have the capability to influence catchability and catch rate of species within estuaries.

(iii) *Market demand*

Market demand is another very important factor which contributes towards catch fluctuations. There are numerous examples throughout the history of the fishery to illustrate how strong and persistent market demand generated greater catches. For example, during the latter years of World War II, when imported food was scarce and canning was commonly practised, the demand for species such as Perth herring and sea mullet was intense. Thus, the catches of these species were elevated, particularly in the Peel-Harvey estuary during 1941 and 1942 (Table 3).

More recently during the early 1970's, there was an increased demand for Perth herring and mullet for use as rock lobster bait, because of the limited availability and increased price of the more traditional baits (Morgan and Barker 1974). Thus, the catches of Perth herring and mullet again received a boost, particularly from the Swan-Canning and Peel-Harvey systems which are both located in close proximity to the rock lobster fishery.

However, there are other species, such as whiting, cobbler and crustaceans which are always in demand as a prime quality food item. Historically, fishermen would have consistently sought these species, and catch rates of these species would more reliably reflect trends in actual abundance.

(iv) *Accuracy of recorded data*

Explanatory notes attached to Tables 2 and 3 cover most problems which have arisen in this area. However, it is as well to note that in particular, inaccurate information from fishermen and to a lesser degree coding errors during data processing can contribute to the observed fluctuations in catch rates and catch. For example, in Table 3(h) 36483 kg of Australian salmon were listed as having been caught in Broke Inlet in 1970. Compared with the relatively small catches of all other years, the 1971 reported catch is very high, particularly from only two fishermen who fished for only three months of the year (the period during which the estuary is open to commercial fishing) and who reportedly also caught 8931 kg of other species. Clearly, the fish were caught outside the estuary, but have been incorrectly assigned, most probably by the fishermen, as having come from the estuary. Fortunately, most such obvious instances can be identified and appropriate allowances can be made when using such data.

B. Use of catch and effort data

Estuarine fisheries differ from most traditional single species marine fisheries, in which the assumptions are made that:

(i) environmental conditions are usually relatively stable,

(ii) the entire unit stock is available for exploitation,

(iii) the distribution of fish in relation to fishing effort is uniform or random, the chosen unit of recorded effort accurately reflecting the more subtle changes in fishing intensity.

In this situation fluctuations in catch are usually directly related to the levels of effort expended, and provided the effort is standardised, then catch per unit of effort (CPUE) usually provides the best available index of stock abundance.

Compared with traditional single species resources , estuarine species display the greatest population variability for only a moderate population magnitude (or expectation) (F.A.O. 1978). In addition, estuarine exploitation regimes are complicated. In Western Australia although only a few species normally predominate in the catch of any one of a number of different unit operations i.e. seine netting, trapping, gill netting, and handlining (mostly amateur), up to ten species can be taken simultaneously in one of these operations. Target species can vary daily, seasonally, and also between estuaries; and mostly effort is not applied randomly or uniformly over the unit stock. In other words estuarine fisheries can be thought of as multistock, multispecies, and multigear fisheries. It is not always possible to allocate proportionally the recorded effort (men and boats) to each species in such fisheries. In practical terms this precludes the use of available CPUE data as an index of overall stock abundance. Further, for fishes which adopt strategies 2 and 3 above, there is the additional complication that those fish which are present within the estuary comprise only part of the whole stock, the oceanic component of which is not confined to coastal waters where commercially fished estuaries are located, but is distributed a considerable distance to the north of the west coast estuaries and east of the commercial south coast estuaries (Chubb et al. 1979). Thus at best CPUE data provide a rather poor index of the overall unit stock abundance of the majority of commercial species that are caught in the temperate estuaries of Western Australia. Nevertheless, CPUE data can provide a relatively good index of the abundance of that part of the stock of a particular species present in a given estuary, such as the Swan-Canning or Peel-Harvey (Lenanton et al. in press). As such it also provides an index of the condition or state of an estuarine fishery.

VI THE STATE OF THE FISHERIES

A. Comparisons between species

Noting the reservations referred to in the previous section the recorded catch per unit of effort (CPUE) data can be used to provide an indication of the state of the individual fisheries of each of the commercially important estuarine systems. This is particularly true of fishes which adopt strategies two and three (V(i) above). When reviewing the CPUE trends of these species in an individual estuary, and having noted (Section V) that the numerous factors which affect the magnitude of catches vary from estuary to estuary, it is most unlikely that there would ever be a consistantly decreasing trend in the CPUE of a given species in all estuaries simultaneously. However, if one was detected it would be reasonable to conclude that the overall level of stock abundance of that species may be declining. Although this type of trend could also be interpreted as the estuarine habitat generally becoming less "useful" to the species, such an explanation is less likely because it would be unusual for all estuarine habitats to deteriorate or change in such a way as to preclude the same species from each system simultaneously. Habitat change would be much more likely to be estuarine specific and thus result in the changing trends in CPUE in a single estuarine system e.g. such as those that have recently occurred in the Peel-Harvey (see p. 46), rather than in all systems.

From Table 5, it is apparent that the catch of eleven of the group of some thirty six commercial "species" of strategies 2 and 3 usually exceeds 10 000 kg annually. The long term CPUE trends for each of these species show fluctuations, which in some instances are rather extreme. However, there appears to be no consistent long-term downward trend in the CPUE of any one of these species, either simultaneously throughout all estuarine systems, or in any one estuarine system (Table 3).

Fishes of strategy 1 e.g. black bream, do present rather a different situation. Provided, as is implied by the definition of the strategy, that for a period there is no interchange between the populations in the estuary and those in the marine environment or in other estuaries, then of the four species which adopt this strategy whose catches exceed 10 000 kg annually (Table 5), possibly the CPUE trends of cobbler, flathead and anchovy/whitebait from selected estuaries may provide an index of the state of their respective unit stocks over that period during which they were confined to that estuary.

Although it is believed that the remaining member of the group, i.e. Perth herring, can reproduce and live till at least maturity entirely within an estuarine system, older fish do move between the estuary and the ocean and perhaps other estuaries. Thus individual estuarine CPUE trends probably provide little indication of overall stock levels of this species although because it is a fluvial anadromous* (Nikolsky 1963) species, decreasing CPUE trends may indicate that conditions which favour breeding or young survival and growth have deteriorated.

*Moving from the sea to the upper estuary/lower riverine regions to spawn.

Although they do not contribute greatly to the commercial estuarine catch, black bream and yellowtail perch are two species which are truly estuarine, a separate discrete population of each of these species being supported in individual estuarine systems. Thus despite obvious constraints imposed by closed waters CPUE trends within these estuaries probably provide an indication of the status of the respective estuarine stocks. Accepting this, indications are that black bream populations are declining in the Peel-Harvey estuary, Wilson Inlet and to a lesser degree Oyster Harbour. Similarly yellowtail perch populations in the Swan-Canning, Peel-Harvey and Leschenault estuaries appear to have declined noticeably. However, this trend could in some way be influenced by the reduced demand in recent years for this species for use as rock lobster bait.

B. Comparisons between estuaries

Examination of the composition of the various estuarine catches has enabled many interesting comparisons to be made between the fisheries in each of the different commercial estuaries of the State. The most obvious is that generally speaking, species that are able to, tend mostly to utilize estuaries which lie well within their range of geographic distribution. For example sea mullet, yelloweye mullet, cobbler and King George whiting which are all widely distributed in both the lower west and south coasts are all important contributors to the fish catch from the temperate estuaries of both coasts. Catches of others such as western sand whiting are more plentiful in west coast estuaries while Australian herring is a dominant component of the catches from south coast estuaries. Although these two species occur in waters off both the west and south coasts, western sand whiting tends to be most abundant in lower to middle west coast areas, in particular the Shark Bay area (Lenanton 1970), while Australian herring is most abundant in waters off the south coast.

In contrast to species mentioned above such as the mullets, there are some species which are confined to either the west or south coasts and which are only represented in catches from estuaries situated on these coasts. Perth herring, a major contributor to the west coast estuarine catch, and to a lesser extent yellowtail perch are both restricted in distribution entirely to the west coast. Similarly the long snouted flounder, and the commercial leatherjacket species taken in waters off Albany, do not occur on the west coast. The significance of the south west corner, or more specifically the Cape Naturaliste area of the State as a zoogeographic barrier is discussed in more detail by Chubb et al (1979).

In contrast to other permanently open south coast estuarine systems, it is notable that Princess Royal Harbour-King George Sound (block 9504) supports a rather diverse commercial fish fauna, the principal components (annual catch exceeding 10 000 kg, Table 5) consisting of the basically stenohaline species such as pilchard, Australian herring and leatherjacket

(Table 3). This is clearly due to the fact that Princess Royal Harbour and King George Sound receives very little freshwater input, and thus the salinity is usually relatively stable annually at about seawater concentration. Thus, the environment is one more typical of a marine embayment being able to support a diverse and abundant fish fauna of inshore-marine stenohaline species.

One of the most interesting comparisons is the striking difference between the fisheries of the two permanently open and adjacently situated Swan-Canning and Peel-Harvey estuarine systems. Historically, greater catches of western sand whiting, King George whiting, sea garfish and prawns have come from the Peel-Harvey system, while greater catches of flathead, pilchards, and to a lesser extent flounder have been taken from the Swan-Canning system, even though all these species are common to both systems (Table 3) (Chubb et al. 1979).

Recently it has been noted (Chubb et al. 1979) that certain species, such as King George whiting, western sand whiting and sea garfish, that could be expected to utilise extensively the Swan-Canning system are only present in very small numbers. The explanation offered by the authors is that these species tend to move away from the frequent and extreme disturbance created in the water and river bottom by the movement of the many large ships that enter the narrow Fremantle Harbour which is located in the lower estuary. These species are in fact much less abundant in the Swan-Canning than in adjacent relatively undisturbed systems such as the Peel-Harvey.

This point of view is not new. It was first expressed as early as the 1890's (Thompson 1898). At that time it was considered that the Swan-Canning system could never be important commercially because the "varied disturbing influences of the variety of operations common to sea ports so largely frequented by shipping as Fremantle is, must affect the fish entering the system, particularly the anadromous species". Several years later, Gale (1901), stated that during 1900, blasting in order to construct Fremantle harbour tended to stop mullet entering the estuary. However, in 1901 when the blasting ceased, many more mullet came into the river (Gale 1902).

Clearly, there are other possible explanations. The differences in catch composition could also be related to the rather different habitat offered by the two systems; extensive shallows in the Peel-Harvey compared with greater areas of deeper water in the Swan-Canning. However, whatever the reason, the difference in catch composition between the two estuarine systems is certainly significant both with regard to the commercial and amateur fishery.

C. The status of estuarine catches

Table 7 has been prepared in an attempt to place the commercial estuarine fisheries in perspective with the scale fisheries of the remainder of the State. This table enables the comparison of the estuarine catches of the 15 most important estuarine fish

species together with crabs and prawns, with the total State production of these species in each of the years 1965, 1970 and 1975. Man days and boat days expended are also included as is the total State production of all species of scale fish for these years.

Although this exercise has only been done for three years over the 1965/75 period of the fishery (there are insufficient data to treat earlier years in the fishery in the same manner) it serves to illustrate some important trends.

(i) Over the 10 year period an increasing proportion of the State's commercial catches of yelloweye mullet, sea mullet, cobbler, Perth herring, western sand whiting, tailor, mulloway and flathead have come from the estuarine fisheries of temperate Western Australia, while fishing effort in terms of man and boat days remained relatively stable. Although the estuarine catches of a number of other species listed in Table 7 have also increased, the catches made from areas other than estuaries have increased by a greater amount causing the estuarine catches, as a percentage of the overall catches, to decrease. This is particularly true of crabs and pilchards, both of which have been caught in increasing numbers in Cockburn Sound over recent years as a food item for metropolitan consumers, and rock lobster bait respectively.

(ii) In 1975 over 90% of the State's annual commercial production of yelloweye mullet, cobbler, Perth herring and flathead, and over 50% of sea mullet, King George whiting, tailor, mulloway, leatherjackets and crabs came from the estuarine fishery of temperate Western Australia. Thus the temperate estuaries of Western Australia produce significant quantities of the State's bait fish such as Perth herring, yelloweye mullet and pilchards; and good quantities of high quality seafood such as cobbler, flathead, King George whiting and crabs.

D. Potential for increased commercial catches

Historically the estuarine commercial catches of most of the species have fluctuated around a relatively stable mean level (Table 8). Thus it is difficult to envisage any real prospect of significantly increasing these estuarine catches markedly above those highest levels that have been achieved in past years, particularly when considering the increasing rate of both habitat alteration and estuarine recreational usage which has been experienced over recent years. However, if the overall level of commercial catches were to be increased, it is most likely that they would result from measures to increase productivity (Nikolsky 1969). A number of techniques which have been employed to improve productivity and ultimately fisheries in coastal lagoons and estuaries in developing countries throughout the world have been reported by Kapetsky (1981). They include hydraulic management, predator control, stocking, artificial nursery areas, brush park fisheries and

aquaculture. Hydraulic management has been attempted with some success in Western Australia (Lenanton 1974c).

Aquaculture could possibly be employed in an attempt to increase the productivity of several commercial species. However, in view of the present regime of estuarine usage in Western Australia, it is difficult to envisage the significant development of such techniques; with the possible exception of cage culture of selected species such as trout, or cobbler, or the culture of mussels or oysters.

Uncontrolled enrichment is commonplace in our estuarine systems as a consequence of human activities associated with this environment in particular river catchments. The Peel-Harvey estuary is a good example of a system that during the initial period of increased levels of enrichment experienced an increase in fish production (Lenanton et al in press).

There appears to be very little potential for the exploitation of additional species. However, the introduction of new processing procedures may encourage some species, which at present are principally caught as bait species, to be used for human consumption. For example whitebait, formally only used as angler bait is now in demand as a deep fried gourmet item in Perth restaurants. Perth herring are excellent marinated, and according to earlier reports (Saville-Kent 1893-4), a very edible product when smoked.

Thus, the capacity to increase commercial fish catches from our estuaries significantly would appear to be limited. The best that can be hoped for is to ensure that both the existing fish stocks and the estuarine environment are well managed.

VII PRESENT AND FUTURE MANAGEMENT

Besides having a good knowledge of the catching characteristics of estuarine fisheries, it is important, from the point of view of responsible management of these fisheries to understand and ideally predict, the effect of all forms of exploitation on both the estuarine component and total stock of each economically important fish species.

It is clear from Section VI, that single species models cannot be used to gain an understanding of the effects of exploitation on abundance of the estuarine component of fish stocks.

Also, for the same reasons as those referred to above, it is difficult to see how any of the multi-species models reviewed by Hongskul (1979) could be used.

A start has been made on the process of understanding inter-specific relationships in estuarine fish communities, with priority at present being given to economically important species. Studies of natural history, particularly early life history, movement and feeding habits have been undertaken (Chubb et al. 1981) with a view to ultimately achieving a good

understanding of the energy pathways of the fish and related communities of the estuarine ecosystem. Certainly this approach has been practised in other parts of the world (Milne and Dunnet 1972; de Sylva 1975). However, the success of modelling such systems depends critically on the quality of the data on which the models are based. Attempts have been made to model fish production in estuaries in a number of countries of the world, with a view to maximising the harvestable crop (Saila 1975). However, it will be some time before sufficiently good data are available to enable the dynamics of Western Australian estuarine ecosystems to be accurately modelled in this way and thus provide a capability to enable a more precise prediction of the effects of fishing on the estuarine fish and related biological community.

For the time being, managers must be content with using the accumulating knowledge of the life history and food web structure of these estuarine fish communities, as a biological basis for management.

Political, economic and social considerations, arising out of problems such as estuarine resource usage strategies and conflicts, clearly also must play a large part in the ultimate management decision in this heavily utilised area of the coastal aquatic environment.

Because of the variation in these factors and the biological characteristics between estuaries, precise management regulations are likely to vary from estuary to estuary (i.e. regionally). This is particularly true of regulations relating to closed seasons, closed areas and gear specifications.

However, the overall management objective is to achieve a satisfactory economic return to professional fishermen, while providing amateurs with acceptable levels of recreational opportunity; and at the same time taking care not to overexploit the fish stocks. This objective generally applies throughout all estuarine fisheries in this State. However it is important that the number of professional fishermen that are able to share this relatively constant supply of fish should not exceed a level whereby each fisherman ceases to receive an economic return for his efforts.

At present the conditional licensing system is attempting to ensure that this does not happen for the commercial fishermen. However, amateur fishing, much of which is conducted in estuaries, and aimed at species such as whiting, bream, tailor, mulloway and flathead is growing very quickly (Caputi and Lenanton 1977; Lenanton 1979) and presumably taking a larger share of this relatively stable resource (Lenanton and Caputi 1975; Lenanton and Hall 1976). Furthermore amateur fishermen are able to exploit fish populations to a very low level, because unlike professionals they are not concerned with obtaining an economic return for their efforts. Thus sustained intensive amateur effort may seasonally reduce the abundance of certain species to levels which would make commercial exploitation unacceptable economically. Therefore it would be useful,

and perhaps in the very near future necessary, from the point of view of responsible management of our estuarine fisheries, to determine the relative proportions of the estuarine fish resource taken annually by the licensed and unlicensed components of the amateur fishery.

VIII SUMMARY OF CONCLUSIONS RELEVANT TO MANAGEMENT

Presented below is a brief summary of conclusions relevant to the management of the commercial estuarine fisheries of south Western Australia.

A. Commercial estuarine fisheries of south Western Australia are multispecies in nature, with over twenty species being taken in a single estuary annually using only two basic fishing methods; i.e. setting and hauling gill nets. Although only a few species normally predominate, at times as many as ten species can be taken in a single fishing operation. Thus, it can be difficult to determine the proportion of the total effort which was expended in order to catch each species. This together with factors such as the varied life history strategies adopted by the different species, distribution of effort relative to stock distribution, and fluctuating demand for the different species practically precludes the use of available CPUE data as an index of overall stock abundance. However, it has been shown that for some estuaries, days spent fishing is directly proportional to the number of boats fishing each month. Therefore, catch per boat is equivalent to catch per day, and provides a good index of abundance of the proportion of the particular species stock present in a given estuary.

B. Catch per boat also provides an index of the condition of each of the individual estuarine fisheries (i.e. Swan-Canning, Peel-Harvey, etc.,) from year to year, noting that in some instances, commercial catches may be much less than amateur catches taken over the same period.

C. The nature of the estuarine fisheries makes the use of traditional multispecies models to gain an understanding of the dynamics of these fish populations extremely difficult. Thus, an ecological approach has been attempted in order to achieve an understanding of the interspecies relationships in estuarine fish communities. At present this involves the study of the natural history of selected species in particular the early life history strategies and feeding habits, and is being used as a biological basis for management. Ultimately, it is hoped that this information will contribute towards an understanding of the energy budgets of fish and related communities of the Western Australian estuarine ecosystem.

D. Particular attention should be focussed on all economically important species, particularly those which adopt the estuary as their only permanent habitat, as clearly

the potential for these populations to be overfished is far greater than it is for the other species which use the estuary either basically as a nursery area, or a protective feeding area for the maturing and mature portions of their populations.

In most instances, estuarine populations of species which adopt the latter two strategies mentioned above, should be managed on a seasonal basis with the principal objective to ensure that all potential users obtain a worthwhile share of the resource while it is present in the estuary. In this regard it should be noted that the economic return to each commercial fishing unit to a large extent dictates the number of units permitted to operate in each of these fisheries. It is important to note here that there is no control on the amount of amateur effort expended on estuarine fish populations.

One of the major considerations in regard to (iv) and (v) above is to ensure that the estuarine environment remains in a condition that is most acceptable to exploited fish species. This will tend to maximise the utilisation of this environment by these species, and consequently provide the opportunity for maximum catches for professionals and amateurs alike.

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IX REFERENCES

Aldrich, F. (1917). Report on the fishing industry for the year 1916 by the Chief Inspector of Fisheries.

Aldrich, F. (1921). Report on the fishing industry for the year 1920 by the Chief Inspector of Fisheries.

Aldrich, F. (1922). Report on the fishing industry for the year 1921 by the Chief Inspector of Fisheries.

Aldrich, F. (1923). Report on the fishing industry for the year 1922 by the Chief Inspector of Fisheries.

Aldrich, F. (1924). Report on the fishing industry for the year 1923 by the Chief Inspector of Fisheries.

Aldrich, F. (1925). Report on the fishing industry for the year 1924 by the Chief Inspector of Fisheries.

Aldrich, F. (1926). Report on the fishing industry for the year 1925 by the Chief Inspector of Fisheries.

Aldrich, F. (1927). Report on the fishing industry for the year 1926 by the Chief Inspector of Fisheries.

Aldrich, F. (1928). Report on the fishing industry for the year 1927 by the Chief Inspector of Fisheries.

Aldrich, F. (1929a). Net and line fisheries. Present and potential (Government Printer: Perth).

Aldrich, F. (1929b). Report on the fishing industry for the year 1928 by the Chief Inspector of Fisheries.

Aldrich, F. (1930). Report on the fishing industry for the year 1929 by the Chief Inspector of Fisheries.

Aldrich, F. (1931). Report on the fishing industry for the year 1930 by the Chief Inspector of Fisheries.

Aldrich, F. (1934). Report on the fishing industry for the year 1933 by the Chief Inspector of Fisheries.

Aldrich, F. (1938). Report on the fishing industry for the year 1937 by the Chief Inspector of Fisheries.

Caputi, N. and Lenanton R.C.J. (1977). A survey of the recreational usage of the south coastal estuaries of Western Australia. *Rep. Fish. Dep. Wet. Aust.* 27, 1-41.

Hutchins, J.B., Lenanton, R.C.J. and Potter, I.C. (1979). An annotated checklist of the fishes of the Swan-Avon river system, Western Australia. *Rec. West. Aust. Mus.* 8(1), 1-55.

Chubb, C.F., Potter, I.C., Grant, C.J., Lenanton, R.C.J., Wallace, J. (1981). Age structure, growth rates and movements of sea mullet, *Mugil cephalus* L., and yelloweye mullet, *Aldrichetta forsteri* (Valenciennes) in the Swan-Avon river system, Western Australia. *Aust. J. Mar. Freshwater Res.* 32(4) 605-28.

Colbatch, Sir H. (ed.) (1929). A story of a hundred years: Western Australia 1829-1929. (Government Printer: Perth).

de Sylva, D.P. (1975). "Nektonic food webs in estuaries". *In* Ed. L.E. Cronin. Estuarine Research Vol. 1, pp 420-47. (Academic Press: New York, London).

Department of Fisheries and Wildlife (1978). State of the Fisheries of Western Australia 1977-78. (Department of Fisheries and Wildlife: Perth, Western Australia).

F.A.O. (1978). Some scientific problems of multispecies fisheries. Report of the Expert Consultation on Management of Multispecies Fisheries, Rome, Italy. 20-23 September 1977. *FAO Fish. Tech. Pap.*, 181, 1-42.

Fraser, A.J. (1939). Report on the fishing industry for the year 1938 by the Chief Inspector of Fisheries.

Gale, C.F. (1900). Report on the fishing industry for the year 1899 by the Chief Inspector of Fisheries.

Gale, C.F., (1901). Report on the fishing industry for the year 1900. (Government Printer: Perth).

Gale, C.F. (1902). Report on the fishing industry for the year 1901 by the Chief Inspector of Fisheries.

Gale, C.F. (1904). Report on the fishing industry for the year 1903 by the Chief Inspector of Fisheries.

Gale, C.F. (1906). Report on the fishing industry for the year 1905 by the Chief Inspector of Fisheries.

Gale, C.F. (1908). Report on the fishing industry for the year 1907 by the Chief Inspector of Fisheries.

Gale, C.F. (1910). Report on the fishing industry for the year of 1909 by the Chief Inspector of Fisheries.

Gentilli, J. (1969). The Swan River and its estuary - A review *Western Geographer Hesperides*, 7-16.

Hodgkin, E.P. (1974). Biological aspects of coastal zone development in Western Australia: I General aspects. *In* "The impact of human activities on coastal zones" Proceedings of the Australian UNESCO committee for man and the biosphere. National symposium, Sydney, May 1973.

Hodgkin, E.P., Birch, P.B., Black, R.E. and Humphries, R.B. (1981). The Peel-Harvey Estuarine System Study (1976-1980). Department of Conservation and Environment, Western Australia, Report 9, 1-72.

Hodgkin, E.P., and Lenanton, R.C.J. (1981) "Estuaries and coastal lagoons in South Western Australia" *In* Eds. B.J. Neilson and L.E. Cronin, Estuaries and Nutrients p 307-21 (Humana Press: New Jersey).

Hongskul, V. (1979). "Report on the studies of multispecies systems in Fisheries" *In* Interim Report of the ACMRR Working Party on the scientific basis of determining management measures. *FAO Fisheries Circular* 718, 73-84.

Johnston, R. (1976). "Mechanisms and problems of marine pollution in relation to commercial fisheries". *In* Ed. R. Johnston. Marine Pollution p 3-151, (Academic Press: London, New York).

Kapetsky, J.M. (1981). Some considerations for the management of coastal lagoon and estuarine fisheries *FAO Fish. Tech. Pap.* 218, 47.

Lenanton, R.C.J. (1970). The biology of the commercially fished whiting (*Sillago spp.*) from Shark Bay, Western Australia. MSc Thesis, University of Western Australia.

Lenanton, R.C.J. (1974a). Fish and crustacea of the Western Australian south coast rivers and estuaries *Fish. Res. Bull. West. Aust.* 13, 1-17.

Lenanton, R.C.J. (1974b). Biological aspects of coastal zone development in Western Australia, II Fish and Birds. *In*. "The impact of human activities, on coastal zones". Proceedings of the Australian UNESCO Committee for men and the biosphere. National symposium. Sydney, May 1973.

Lenanton, R.C.J. (1974c). Wilson Inlet. A seasonally closed Western Australian south coast estuary. *Rep. Fish. Dep. West. Aust.* 14, 1-32.

Lenanton, R.C.J. (1977). Aspects of the ecology of fish and commercial crustaceans of the Blackwood River estuary, Western Australia. *Fish. Res. Bull. West. Aust.* 19, 1-72.

Lenanton, R.C.J. (1978). Fish and exploited crustaceans of the Swan-Canning estuary. *Rep. Fish. Dep. West. Aust.* 35, 1-36.

Lenanton, R.C.J. (1979). The inshore marine and estuarine licensed amateur fishery of Western Australia. *Fish. Res. Bull. West. Aust.* 23, 1-33.

Lenanton, R.C.J. and Caputi, N. (1975). The estimation of catches by amateur and professional fishermen of the Blackwood River estuary during 1974-75. Report to the Estuarine and Marine Advisory Committee of the Western Australian Environmental Protection Authority, Perth.

Lenanton, R.C.J. and Hall , N. (1976). The Western Australian amateur fishery for Australian herring (*Arripis georgianus*). Results of the 1973 creel census. *Rep. Fish. Dep. West. Aust.* 25, 1-59.

Lenanton, R.C.J., Potter I.C., Loneragan, N.R. and Chrystal, P.J. (in press). Age structure and changes in abundance of three important species of teleost in a eutrophic estuary. J. Zool. (Lond.).

Marks, P.J., Plaskett. D., Potter, I.C. and Bradley, J.S. (1980). Relationship between concentration of heavy metals in muscle tissue and body weight of fish from the Swan-Avon estuary, Western Australia. *Aust. J. Mar. Freshwater Res.* 31(6), 783-92.

McComb, A.J., Atkins, R.P., Birch, P.B., Gordon, D.M. and Lukatelich, R.J. (1981). Eutrophication in the Peel-Harvey estuarine system, Western Australia In Eds. B.J. Neilson and L.E. Cronin, Estuaries and Nutrients. p 323-42 (Humana Press: New Jersey).

Milne, H. and Dunnet, G.M. (1972). "Standing crop productivity and trophic relations of the fauna of the Ythan estuary". *In* Ed. R.S.K. Barnes and J. Green. The estuarine environment p 86-102. (Applied Science Publishers Ltd London).

Morgan, G.R. and Barker, H.E. (1974). The western rock lobster fishery 1972-73. *Rep. Fish. Dep. West. Aust.* 15, 1-22.

Morgan, R. P.II, Ulanowiez, R.E., Rasin, J.R. Jr., Noe, L.A. and Gray, G.B. (1976). Effects of shear on eggs and larvae of striped bass *Morone saxatiles* and white perch. *M. americana Trans. Amer. Fish. Soc.* 105(1), 149-54.

Moore, P.G. (1977). Inorganic particulate suspensions in the sea and their effects on marine animals. *Oceanogr. Mar. Biol. Ann. Rev.* 15, 225-363.

Nikolsky, G.V. (1963). The ecology of fishes. p 248 (Academic Press: London, New York).

Nikolsky, G.V. (1969). The theory of fish popoulation dynamics as the biological background for rational exploitation and management of fishery resources (Oliver and Boyd: Edinburgh).

Potter, I.C., Loneragan, N.R., Lenanton, R.C.J., and Chrystal, P.J. (1983). Blue-green algae and fish population changes in a eutrophic estuary. *Marine Pollution bulletin.* 14(6), 228-33.

Saila, S.B. (1975). "Some aspects of fish production and cropping in estuarine systems" *In* Ed. L.E. Cronin. Estuarine Research Vol. 1 pp 473-93 (Academic Press: New York, London).

Saville-Kent, W. (1893-4). "Fish and Fisheries of Western Australia" *In* W.A. Reg. Gen. Western Australian Year Book 1893-4.

Scott, W.D. & Co. Pty Ltd (1969). Report to the Hon. The Minister for Fisheries and Fauna on a pilot study into the economic future of the wet fish industry in Western Australia.

Sheard, K.(1962). The Western Australian Crayfishery 1944-1961 (Paterson Brokensha, Perth).

Slack-Smith, R.J. (1978). Early history of the Shark Bay prawn fishery, Western Australia. *Fish. Res. Bull. West. Aust.* 20, 1-44.

Thompson, L. (1898). Report on the marine fisheries on the south and south-western coasts of the colony of Western Australia, Perth.

Wilber, C.G. (1971), "Turbidity" *In* Ed, O. Kinne, . Marine Ecology vol. 1, Pt 2 pp 1157-1194. (Wiley Interscience: London, New York).

Zieman, J.C. (1976). The ecological effects of physical damage from motor boats on turtle grass beds in southern Florida. *Aquat. Bot.* 2(2), 127-139.

TABLE 1 FISH PRODUCTS* IMPORTED INTO WESTERN AUSTRALIA OVER THE PERIOD 1888-1910

Year	Packages	Pounds	Value (£)	Source
1888	2301		3 014	W.A. Year Book 1895-7
1889	2588		3 545	
1890	3060		2 717	
1891	3436		3 958	
1892	5962		6 833	
1893	3430		3 708	
1894		414 258	8 888	
1895		711 029	15 291	
1896		1 666 533	36 368	
1897		1 706 693	33 877	
1898				
1899		1 348 810	24 838	Gale 1901
1900		1 503 089	31 957	Gale 1901
1901		1 795 457	36 907	Gale 1902
1902		1 792 000	43 672	Gale 1904
1903		1 344 000	35 630	Gale 1904
1904				
1905		1 947 183	46 250	Gale 1906
1906				
1907		1 563 521	32 423	Gale 1908
1908				
1909		No data available		
1910				

* Dried, salted, pickled or preserved.

TABLE 2. ALL AVAILABLE CATCH (KG) AND EFFORT (MEN AND BOATS) DATA FOR COMMERCIAL FISH AND CRUSTACEANS TAKEN FROM THE MAJOR COASTAL WATERS OF TEMPERATE WESTERN AUSTRALIA DURING THE EARLY PERIOD OF THE FISHERY, 1898-1940.

2(a) Swan River

2(b) Mandurah

2(c) Bunbury area

2(d) Albany area

Explanatory notes

Tables 2(a) - (d)

1. Yelloweye mullet (*Aldrichetta forsteri*) were commonly called pilchard during the early period of the fishery.

2. Crab weight (kg) was estimated from dozens assuming 1 dozen = 2.7 kg.

3. Prawn weight (kg) was estimated from gallons assuming 1 gallon = 3.5 kg.

4. Mandurah catch can be considered as having come from Peel-Harvey estuary, because all fish caught in adjacent marine waters could not be landed at Mandurah because of the sand bar across the entrance of the estuary. Thus they were taken direct to Fremantle by sea.

5. Bunbury area catches can be considered as having come from the ocean beaches of Geographe Bay (in particular Koombana Bay) where much netting was carried out; the Vasse-Wonnerup estuary where little net fishing took place, and Leschenault estuary where during these early years, most fish taken were caught by hand line because the estuary was closed to netting.

6. Albany area catches can be considered as having come principally from the waters of Oyster Harbour, Princess Royal Harbour, King George Sound and Wilson Inlet.

7. During the early period of the fishery mullet = sea mullet and Kingfish = mulloway.

(a) SWAN RIVER

Year	Catch (kg) Fish	Crabs	Prawns	Effort Men	Boats	Comment	Source
1899	127273		3500	32	16		Gale, 1900
1900	122182		1006	68	27		Gale, 1901
1901	+ 113455						Gale, 1902
1902							
1903			4200	32	16	Mullet, pilchard, yellowtail, tailor, flathead, Perth herring were caught - precise catch data unavailable.	Gale, 1904
1904	66182		19056	- (32 FT)	26 (17 FT)		Gale, 1905
1905	61091		10500	59 (28 FT)	26 (14 FT)		Gale, 1906
1906	101818			92 (60 FT)	42 (30 FT)		Gale, 1908
1907	122182	5268	35875				Gale, 1908
1908							
1909	115496		4364	77 (30 FT)	33 (15 FT)		Gale, 1910
1910							
1911		732	11968				F&W File 112/40
1912		3710	24272	118	31		F&W File 222/49
1913		5972	18548				F&W File 112/40
1914		3213	17969	44	22		F&W File 242/14
1915		2346	12450	46	23		F&W FIle 429/15
1916	50182	6423	22407	40	20		Aldrich, 1917
1917	105391	9072	23184	48	24		F&W File 112/40
1918		11899	18375	75	33		F&W File 35/18
1919		24165	12586				F&W File 112/40
1920		5775	12327	116 (33 FT)	43 (18 FT)		Aldrich, 1921 File 1876/20
1921		7640	18168	129	49		Aldrich, 1922, F & W File 112/40
1922				106	36		Aldrich, 1923
1923				66	29		Aldrich, 1924
1924				70	35		Aldrich, 1925
1925				82	32		Aldrich, 1926
1926				82	30		Aldrich, 1927
1927				72	22		Aldrich, 1928
1928		16470	61814	83	27		Aldrich, 1929 b
1929				94	29		Aldrich, 1930
1930				108	34		Aldrich, 1931
1933				63	52		Aldrich, 1934
1937				136	52		Aldrich, 1938

FT = Full year (time) fishermen

\+ = Estimated from revenue data

(b) MANDURAH

Year	Catch (kg) Fish	Crabs	Prawns	Effort Men	Boats	Comment	Source
1898	183273			42		Principally mullet.	Gale, 1900
1899	81455			32		Mullet, pilchard, bream, kingfish, whiting, tailor, salmon, trout.	Gale, 1900
1900	76367			40	21	Mullet, pilchard, bream, whiting, herring, snapper, tailor. 6109 kg of fish canned.	Gale, 1901
1901	79418		672	33	18	Mullet, pilchard, bream, kingfish.	Gale, 1902
1902	94691			43	25		Gale, 1904
1903	109961			54	31	Mullet, pilchard, tailor, kingfish, whiting, Perth herring, bream, salmon, snapper.	Gale, 1904
1904	129309			58	32		Gale, 1908
1905	148655			48 (27 FT)	31	24487 kg of the total catch canned, mostly Perth herring and mullet.	Gale, 1906
1906	153245			50	35		Gale, 1908
1907	231127			58 (34 FT)	39 (25 FT)	Increase allegedly related to the earlier closure of the Murray and Serpentine rivers and estuary entrance channel to all forms of netting. 29527 kg of fish canned.	Gale, 1908
1908							
1909	216210			64 (40 FT)	43 (28 FT)	43318 kg of the total catch canned.	Gale, 1910
1910	213766			57	40	23369 kg of the total catch canned.	F&W Files
1911							
1912	161588			52	38	7566 kg of fish canned.	File 222/49 Gen. Stats 1912
1913							
1914							
1915							
1916	135498			31	28	Major species: yelloweye mullet, sea mullet, black bream, sand whiting, tailor, mulloway, cobbler. 12976 kg of fish, mostly mullet canned.	Aldrich, 1917 F&W Files
1917	120415			26	25	Major species: yelloweye mullet, sea mullet, black bream, sand whiting, tailor, mulloway, cobbler.	" "
1918				33	30		
1919	145554			34	32	Major species: yelloweye mullet, sea mullet, black bream, sand whiting, tailor, mulloway, cobbler.	F&W Files
1920	121397			54	43	Major species: yelloweye mullet, sea mullet, black bream, sand whiting, tailor, mulloway, cobbler. 305 kg of fish canned.	F&W Files Aldrich, 1921
1921				54	37		Aldrich, 1922
1922				43	36		Aldrich, 1923
1923				40	35		Aldrich, 1924
1924				39	34		Aldrich, 1925
1925	119415			44	37		Aldrich, 1926
1926	116004			42	38		Aldrich, 1927
1927	71225			42	30		Aldrich, 1928
1928	119251			51	36		Aldrich, 1929
1929				50	34		Aldrich, 1930
1930				51	38		Aldrich, 1931
1931	224770		10605	42	35	Major species: Yelloweye mullet, sea mullet, sand whiting, tailor, cobbler, Perth herring.	F&W Files
1932	249440		7476	49	34	" " "	" "
1933	243851			65	40	" " "	" "
1934	285509			40	30	" " "	" "
1935	190262			50	37	" " "	" "
1936	192657			50	35	" " "	" "
1937	188178		8750	50	44	" " "	" "
1938	160363		7000	58	44	" " "	" "
1939	163792			48	39	" " "	" "
1940	137288		11970	45	35	" " "	" "

FT = Full year (time) fishermen

(c) BUNBURY AREA

Year	Catch (kg) Fish	Crabs	Prawns	Effort Men	Boats	Comment	Source
1900							
1901							
1902							
1903	31564			23	12	Mullet, pilchard, bream, Perth herring, kingfish, snapper and Australian salmon.	Gale, 1904
1904				22	15 Bu		Gale, 1905
				15	7 Bs		
1905	48313			25	12 Bu	Leschenault estuary completely closed to	
				18	9 Bs	netting. Most fish consumed locally. Small quantities sent to Perth and goldfields markets.	Gale, 1906
1906							
1907	29018			13	7 Bu		Gale, 1908
				14	7 Bs		
1908							
1909							
1910							
1911							
1912	13283 Bu			37	15 Bu	An additional 31889 kg caught and disposed	
	16248 Bs			11	7 Bs	of in the Bunbury district and not sold through the Perth market.	F&W File 222/49
1913		No data available	No data available				
1914							
1915							
1916							
1917							
1918							
1919							
1920				23	14 Bu		
				13	6 Bs		Aldrich, 1921
1921				40	22 Bu		
				18	10 Bs		Aldrich, 1922
1922				36	18 Bu		
				15	8 Bs		Aldrich, 1923
1923				25	12 Bu		
				14	9 Bs		Aldrich, 1924
1924				18	14 Bu		
				12	7 Bs		Aldrich, 1925
1925	27275 Bu			21	12 BU		
	36232 Bs			9	6 Bs		Aldrich, 1926
1926	20837 Bu			24	12 Bu		
	39215 Bs			13	6 Bs		Aldrich, 1927
1927	21465 Bu			22	12 Bu		
	28305 Bs			19	8 Bs		Aldrich, 1928
1928	34242 Bu			46	23 Bu	Bunbury catch principally snapper, jewfish	Aldrich, 1929 b
	6121 Bs			13	7 Bs	and other line caught species.	
1929				43	35 Bu		
				10	5 Bs		Aldrich, 1930
1930				46	30 Bs		
				12	8 Bs		Aldrich, 1931
1933				51	22 Bu		
				19	8 Bs		Aldrich, 1934
1937				46	20 Bu		
				18	8 Bs		Aldrich, 1938
1938				31	15 Bu		
				11	6 Bs		Frazer, 1939

Bu = Bunbury area

Bs = Busselton Area

(d) ALBANY AREA

Year	Catch (kg) Fish	Crabs	Prawns	Effort Men	Boats	Comment	Source
1900							
1901							
1902	133382			37	14		Gale, 1904
1903	133382			53	22	Mullet, pilchard, bream, A. salmon trout. flathead, A. herring, plus 8655 kg of barracouta.	Gale, 1904
1904	149393			59 Ave. (30)	26 Ave. (23)	Mullet, flathead, whiting, bream, A. herring, pilchard and a few snapper. Caught in Wilson Inlet, Princess Royal Harbour and Oyster Harbour. Marketed mostly in goldfields, however some were sent to outlying towns, Perth or sold locally.	Gale, 1905
1905							
1906							
1907	122487			37	20	Mullet, bream, whiting, A. herring, pilchard, flathead, garfish, A. salmon trout, pike, barracouta. snapper, leatherjacket and A. salmon.	Gale, 1908
1908							
1909	85743			31	20		Gale, 1910
1910							
1911							
1912	86579			38	21	An additional 96090 kg caught but disposed of locally and <u>not</u> sold through the markets.	F&W File 222/49
1913							
1914							
1915							
1916							
1917							
1918							
1919							
1920				50	22		Aldrich, 1921
1921				53	30		Aldrich, 1922
1922				37	28		Aldrich, 1923
1923				52	30		Aldrich, 1924
1924				41	23		Aldrich, 1925
1925	94770			43	28	Catches tabulated from the Albany district fish returns (including catches from Wilson Inlet and adjacent waters). Quantities additional to those presented here were sold direct to the Albany district public.	Aldrich, 1926 F&W File 50/20
1926	73515			33	25	" " "	Aldrich, 1927
1927	89838			36	27	" " "	Aldrich, 1928
1928	91594			39	26	" " "	Aldrich, 1929 b
1929	91675			46	28	" " "	Aldrich, 1930
1930	91437			52	33	" " "	Aldrich, 1931
1931	81948					" " "	F&W File 50/20
1932	81850					" " "	F&W File 50/20
1933	105258			52	34	" " "	Aldrich, 1934
1937				52	30		Aldrich, 1938
1938				48	32		Frazer, 1939

TABLE 5. ALL AVAILABLE CATCH (KG) AND EFFORT (MEN AND BOATS) DATA FOR COMMERCIAL FISH AND CRUSTACEANS TAKEN FROM THE ESTUARIES OF TEMPERATE WESTERN AUSTRALIA BETWEEN THE EARLY PERIOD OF THE FISHERY AND 1975.

(a) Swan-Canning Estuary

(b) Peel-Harvey Estuary

(c) Leschenault Inlet

(d) Princess Royal Harbour and King George Sound

(e) Oyster Harbour

(f) Wilson Inlet

(g) Irwin Inlet

(h) Broke Inlet

Tables 3(a) - (h)

1. In the Swan-Canning during the years prior to 1922, crab and prawn weights (kg) were derived using respectively the following conversions:

   1 dozen = 2.7 kg; 1 gallon = 3.5 kg.

2. The total netfish figure for Wilson Inlet during the period 1941-51, is clearly an underestimate because it excludes catches of important species such as Australian herring and southern trevally.

3. The catches from Irwin Inlet and Broke Inlet must be considered in the context of the annual open fishing season which usually extends for only 3 or 4 months of the year, depending on the dates when the sand bars across the entrances to these systems opened and closed.

4. Although juveniles of Australian salmon are known to occur in some of the estuaries of south-western Australia, very large catches clearly comprise quantities of fish from the adjacent marine waters which have wrongly been assigned as having come from the estuary.

5. Some professional fishermen, particularly those of the south coast, refer to yelloweye mullet as "pilchard" or "pilch". Thus at times, this species may have been incorrectly coded as pilchard (*Sardinops neopilchardus*).

6. It is most likely that the occasional records of catches of both yellowtail perch and Perth herring from some of the south coast estuaries are inaccurate, because there is no scientific record of these species occurring in estuaries or coastal waters of this section of the coast.

7. Both whitebait and anchovy are taken commercially from a number of estuaries in south-western Australia. Whitebait is consistently in demand, primarily as an angling bait, and increasingly as a gourmet food item. However, at present there is little demand for Anchovy. Quite often both species are taken in the same catching operation. Collectively they have been recorded in the fisheries statistics as Anchovy. However, in reality, most of these catches consist of whitebait.

8. Records of catches under the headings of bream, cod, herring, mullet, or writing "mixed" were only made on occasions when it was not clear from the fisherman's return precisely which species had been caught.

9. There is no scientific record of sand mullet (*Myxus elongatus*) having been taken from the estuaries of south-western Australia. Recorded catches of this species were probably sea mullet (*Mugil cephalus*).

10. The single recorded catch of catfish from the Swan-Canning estuary was most likely to have been cobbler (*Cnidoglanis macrocephalus*).

11. The following species rarely enter Western Australian estuaries, occuring mostly in the inshore-marine environment off the lower west and south coasts of this State:- barracouta (snoek), bonito, buffalo bream, cod, southern rock cod, grouper, Westralian jewfish, yellowtail kingfish, leatherjacket, blue mackerel, dusky morwong, red mullet, short finned pike, red fish, samson fish, shark, skates and rays, queen snapper, sole, sweep, skipjack tuna, and southern bluefin tuna. Thus with the exceptions of perhaps Princess Royal Harbour and King George Sound, which are really marine embayments, relatively large catches of these species would not normally be expected from our estuaries. Therefore, records of such estuarine catches are most probably the result of either fishermen incorrectly assigning their marine catches of these species to an adjacent estuary, or an error in coding the data prior to computer analysis.

    Scaly mackerel and pilchard would normally be included in this group. However over recent years, large catches of pilchard have been taken from the Peel-Harvey estuarine system and the lower reaches of the Swan-Canning estuary.

12. Westralian jewfish is an inshore-marine species which has never been scientifically recorded from the estuaries of south-Western Australia. Thus catches of this species have been wrongly assigned as having come from the estuarine environment. In reality the catches have probably come from and should have been assigned to the adjacent marine commercial fishing block.

13. "Other jacks" = other species of trevally.

(a) SWAN-CANNING ESTUARY

Year	Anchovy	Black bream	Buffalo bream	Catfish	Cobbler	Dusky flathead	Flounder	Sea garfish	Australian herring	Perth herring	Westralian jewfish
1912					496	698	264		23		
1913											
1914					205	283	45				
1915		45			523	795	86			182	
1916											
1917											
1918		536			966	830	1400			42	
1919											
1920					116	800	457	177			
1921					970	856					
1922 to 1937											
1938											
1939		8				909	205			324	
1940		87				155	86	2		151	
1941		64			19662	1167	134		104	14500	
1942		1139			19316	1019	101			79704	
1943		1205			7594	884			49	67783	
1944		208			2801	784	2	236	27	60431	
1945		1496			11788	5494	787		32	50048	
1946		1256			3143	1332	117	5	41	24630	
1947		152			305	991				9205	
1948		723			1543	420					
1949		999			769	159				13600	
1950		1928			1305	379				6375	
1951		614			5592	1007	25			537	
1952		332	0	0	1485	618	0	0	72	419	0
1953		1558	|	|	1957	990	90	|	227	166	4
1954		248	|	|	1284	410	47	|	45	0	0
1955		1177	|	|	3861	1726	219	|	0	1871	|
1956		348	|	|	1056	3012	114	|	188	4278	|
1957	324	1083	|	|	3183	1350	148	|	0	19239	|
1958		459	|	|	5661	956	398	|	|	9192	|
1959		225	|	|	21523	624	194	|	|	8422	|
1960		491	|	|	56586	3869	411	0	|	15946	|
1961		86	|	|	44780	2063	148	5	|	16153	|
1962		279	|	|	49371	2097	31	0	|	11256	|
1963	823	1772	|	|	38259	4707	47	66	0	60361	|
1964	2090	739	|	|	23877	2150	0	0	6210	65266	|
1965	5833	1269	|	|	26098	1157	|	|	3407	43434	|
1966	4113	525	|	0	13475	2133	|	|	0	52340	|
1967	8257	1230	|	911	17434	3652	|	|	427	89701	|
1968	5389	971	|	0	15142	3140	0	|	517	177611	|
1969	7266	72	0	|	29127	2015	34	|	150	62048	|
1970	4944	284	2	|	49554	3076	146	|	39	46518	|
1971	1588	922	0	|	39738	1996	9	0	253	71549	|
1972	3470	1385	2	|	23596	1017	13	5	561	147432	|
1973	12701	3808	0	|	33480	904	28	0	159	158606	|
1974	5215	2220	0	|	40210	1955	1	43	1049	97363	|
1975	16058	1181	0	0	31354	1016	4	0	485	137983	0

FT = Full year (time) fishermen

SWAN CANNING ESTUARY

Year	Leather-jacket	Scaly mackerel	Mullet mixed	Mullet sand	Mullet sea	Mullet yelloweye	Mulloway	Yellowtail perch	Short-finned pike	Pilchard
					118178	2077	361	319		
					57382	12488	1191	216		
					73386	7114	273	4364		
					110205	2250	4902	1505		
					33177	2632	1367	55		
					126072	43762	2606			
to 19										
					5882	138		532		
					1564	322		74		
					30651	5692	171	141		
					12286	1157	172	712		
					9972	1515	968			
					5316	2207	506	697		
					10484	7605	679	1724		
					10101	4034	1861	196		
					19059	3133	982			
					24336	4734	306			
					18513	1119	77			
					24257	2532	155			
					38749	2599	99	21		
	0	0	0	0	20761	1659	38	0	0	0
					19777	2721	27			
					19519	2588	43			
					15386	4631	8	0		0
					20654	1965	72	159		133
					36500	4238	67	1		0
					86276	4987	5	222		
					73883	5657	417	25		0
					42941	20801	639	599		3342
			5		116084	15157	188	1477		0
			725		42390	10051	557	2205		
			4360	0	64784	16268	3667	5285		
			15548	17889			638	6785		0
			13811	0	62761	3624	8452	0		112
			18971		74051	6106	2113	2820		32
			361		57241	8909	1908	3050		81
			2019		36558	5587	5369	1915		89
			1728		52387	17155	3587	811		245
		0	508		69267	29354	3477	927		990
	1	22	340		44941	29406	3884	830		1471
		2	181		48044	11241	1461	98		2866
	0		0	3212	76162	21045	2630	380	0	2590
		228		0	71627	15799	2240	84	2	7564
	0	0	0	0	54097	18995	29815	265	0	2338

(a) SWAN-CANNING ESTUARY

Year	Roach	Australian salmon	Samson fish	Shark, other	Skates, rays other	Snapper	Queen snapper	Sole	Tailor	Tarwhine (silver bream)	Southern trevally (skipjack)
1912	148	614							6241		
1913											
1914	136								3727		
1915	295	136							6954		
1916											
1917											
1918		582			29				9093		
1919											
1920					177				3704		
1921									15541		
1922 to 1937											
1938											
1939									3471		13
1940									1247		
1941		41							4895		493
1942		40		16	41				2308		
1943				87					5945		184
1944		75		45	142				8837		503
1945				7	269				6414		7
1946				96	845				7045		34
1947									8390		
1948									7616		
1949									6377		
1950									5849		
1951				7					5405		
1952	0	0	0	0	0	0	0	0	4218	0	38
1953				361	49				2128		0
1954				0	0				1901		
1955				8	0				1710		0
1956				0	25				2624		37
1957					39				2800		0
1958	0				32				3496		0
1959	42			0	0				3195		5
1960	0			48					4552		0
1961	930			11	0				7977		
1962	1174			0	63				2584	0	0
1963	116		0	0	0				2464	31	38
1964	0	0	188	160		0		0	2769	0	0
1965		708	0	0		357		15	1857		259
1966		14	106	38		0		0	1551	0	0
1967		8	91	0					1552	55	
1968		0	285	0					1871	0	
1969			140	53					2626	0	
1970			0	0	0	0			2904	17	
1971	0	0	1030	308	213	68	0		2330	0	0
1972	58	5	330	10	0	295	12		1684	0	34
1973	33	59	358	61	50	0	0		1899	2947	0
1974	5	0	86	0	0				823	1407	
1975	264	0	93	14	0	0	0	0	2178	0	0

(a) SWAN-CANNING ESTUARY

Year	Trumpeter	Southern Bluefin Tuna	Whiting			Other wetfish	Total wetfish	Crabs	Prawns	Men	Boats
			King George	mixed	western sand						
1912							129419	3710	24272	118	31
1913											
1914							75593	3213	17969	44	22
1915							94153	2346	12450	46	23
1916							50182	6423	22407	40	20
1917							105391	9072	23184	48	24
1918							132340	11899	18375	75	33
1919											
1920				23			42685	5775	12327	116 (33 FT)	43 (18 FT)
1921						36812	226619	7640	18168	129	49
1922 to 1937											
1938								12720	7396	156	68
1939				25			11507	11316	2797	63	32
1940							3688	14118	126	61	31
1941						74	77789	13605	510	19	15
1942							118011	11951	93	30	20
1943						976	97162	3127	0	20	7
1944						15	82832	3958	0		
1945							96834	23914	76		
1946				179		204	55119	7370	1996		
1947						578	42795	5335	3610	31	19
1948						668	40346	14838	11150		
1949						279	41892	16659	2209	25 (15 FT)	(12FT)
1950						50	42830	22525	1203	28 (14 FT)	
1951						153	54808	18014	2719		
1952	14	0	0	0	1	0	29655	9609	143	16	13
1953	0	|	|	|	0	|	30055	16745	86	18	15
1954	|	|	|	|	|	0	26085	6958	12	13	12
1955	|	|	|	|	|	50	30647	7573	3	14	13
1956	|	|	|	|	|	14	34679	8215	6569	15	14
1957	|	|	|	|	|	11	68983	3891	8662	17	15
1958	|	|	|	|	|	0	111684	11382	1678	20	19
1959	|	|	|	|	|	|	114212	10176	14217	24	22
1960	0	|	|	|	0	|	150225	22226	7893	30	27
1961	3	|	|	|	14	|	205076	10415	1013	34	30
1962	0	|	|	|	57	0	122840	8696	1132	23	20
1963	|	|	|	0	341	296	203685	1730	529	29	25
1964	|	|	|	33	0	4179	148491	680	2595	22	19
1965	|	|	|	0	10	15778	208942	1741	2298	27	22
1966	|	|	|	|	0	825	179213	1201	2290	25	22
1967	|	|	|	|	77	3	194950	8780	784	29	24
1968	|	|	|	|	14	90	256567	15392	270	31	25
1969	|	|	0	|	1	1419	180864	7038	745	34	27
1970	|	|	53	|	56	135	212249	3316	1286	30	25
1971	|	|	0	|	51	136	201333	12711	953	33	27
1972	|	0	81	|	25	0	243984	16179	225	33	27
1973	|	150	56	|	167	139	322021	12898	477	33	27
1974	|	0	124	|	116	301	248482	22700	172	33	28
1975	0	0	0	0	30	733	296913	21249	3168	31	26

(b) PEEL-HARVEY ESTUARY

Year	Anchovy	Black bream	Buffalo bream	Cobbler	Cod	Dusky flathead	Flounder	Garfish sea (river)	Groper	Australian herring	Perth herring	Westralian jewfish	Yellowtail kingfish	Leather-jacket
1941				19780				625		470	2688			
1942		297		55449				2259		14	29924			
1943		416		84586				1075		46	27057			
1944		153		56099							17690			
1945		756		49071							9905			
1946		281		3570		1		2125		685	7455			
1947			504	808		3	3	5669		2	6242			
1948		119		2217			31	5618		72	1177			
1949		406									3344			
1950		40									3377			
1951		26									7487			
1952	0	22	0	206725	0	19	47	3788	0	481	482	353	0	0
1953		126		198679	53	6	54	2918		1238	2525	350		
1954		9		164316	0	19	91	2062		78	2698	0		
1955		12		265238		0	69	2070		244	8989			
1956		29		173544		9	10	2402		64	3268			
1957		1008		35928		0	29	1972		576	6880			
1958		839		37052		0	118	2535		78	5349			
1959		107		75427		1	90	2365		0	17602			
1960		254		168342	0	1	9	1931		60	32641	0		
1961		0		297998	3	1	32	5535		0	15749	39		
1962		72		190898	0	14	85	4866			19956	0		
1963	0	1233		147643		9	61	2293		0	14301			
1964	1064	180		63510		0	0	691		3719	53550			
1965	2533	107		11181		5	0	655		71	4916			
1966	0	16		9641		91	8	400		84	18167			
1967	3123	0		10813		0	0	687		340	6086			
1968	687			5740			3	270		163	21249			
1969	1343	0		7580		0	0	180		109	1547			
1970	0	8		34658		8	27	913		344	18277			0
1971	0	18	0	97230		8	16	600		219	28633		0	44
1972	1215	110	42	134447		0	0	869		217	10380		10	0
1973	916	10	0	204791			0	1017	0	595	1136	0	0	14
1974	4160	0		218436			25	1572	125	432	11428	25	45	4
1975	1561	0	0	51574	0	0	7	4233	0	693	1908	0	0	24

(i) PEEL HARVEY ESTUARY

Year	Scaly mackerel	Sand mullet	Sea mullet	Yelloweye mullet	Mulloway	Yellowtail perch	Pilchard	Roach	Australian salmon	Samson fish	Shark, other	Skates, rays, other.	Snapper	Sweep	Tailor
1941			51167	85150	2892				676						2887
1942			27238	58340	1381				81						1569
1943			10573	63293	2181				88						8223
1944			12310	83285											
1945			36013	71483											
1946			17361	49461	1166	836			22						4855
1947			20300	40026	372	114			504			42			12720
1948			26031	44788	248	206			659			13			8972
1949			43904	53266	400										
1950			51758	49424	1863										
1951			66636	105451	1427										
1952	0	0	64031	77532	1969	716	0	1843	3	0	139	106	169	3	4602
1953			42832	62104	641	360		794	0		543	0	160	25	3705
1954			53726	62810	581	439		778	87		0	11	0	0	4077
1955			72000	100418	1788	1219		125	0		0	21			4973
1956			94122	84966	449	547		305	23		11	0			4683
1957			109804	146454	2210	69		56	152		0	0			9702
1958			68815	112429	542	246		0	2			54			10252
1959			90961	92493	529	464		181	35		0	20			6568
1960			60405	138068	563	273	0	0	170		22	56			9912
1961			138696	89327	21	653	1162	41	1382		1556	147			11442
1962			109576	141824	562	1586	0	0	87		0	68			4666
1963			119073	100378	1580	1265	0	23	0	0	0	63			12876
1964			144025	92996	978	1820	81	0	214	49	1549	0			13102
1965			99694	144231	1732	635	2769		100	0	17172				19605
1966			108182	224775	3213	346	0		62	26	3723				7224
1967	0		126828	175160	1947	126	382		113	56	5533		0		11582
1968	227		63603	139988	2468	15	0		20171	0	9772		78		9465
1969	565		77596	134854	448	64	127		2196	0	0		69		6737
1970	227		114309	170869	197	123	16		878	55	29		0		9696
1971	761		99315	103074	181	11	2680		67	33	166				18620
1972	6278	0	194522	130244	57	20	7978		336	6	0				7658
1973	2423	43	211772	131130	185	370	0		81	24	505		0		1751
1974	0	78	245884	162354	810	0	12857	0	55	140	1414		16794		8500
1975	0	0	260151	313520	1305	0	34827	54	0	0	0	0	0	0	21574

(b) PEEL-HARVEY ESTUARY

Year	Tarwhine (silver bream)	Southern trevally (skipjack)	Trumpeter	Whitebait	King George whiting	Western sand whiting	Other wetfish	Total wetfish	Crabs	Prawns	Men	Boats
1941						7009	4659	178003		11651	49	35
1942						3986	2497	183035		9874	43	29
1943						12489	2142	212169		22431	28	22
1944						8843	29324	207704		15575	43	N.A.
1945						7631	54532	229391		2272	36	"
1946	1				623	6568		95010	133	16071	40	"
1947					4072	4376		95241		9762	38	"
1948		45			27789	848	8201	126976		253	49	"
1949						2104	42008	145432		6533	40	"
1950						5029	55413	166904		8054	37	"
1951						9699	59925	250561	73	7978	38	"
1952	6	105	6	0	1303	4063	334	368847	13	12643	51	38
1953	27	464	0		1695	5184	38	324521	515	15954	51	36
1954	501	0			2512	9875	0	304661	351	17205	50	36
1955	12				303	12629	9	470119	374	8440	60	48
1956	275	0		0	526	15629	5	380867	6	35249	58	44
1957	0	5		733	10776	16051	0	342405	544	73197	61	51
1958	0	250		0	41643	10337		290541	331	40024	56	48
1959	117	0			6307	3334		296601	2516	17739	52	46
1960	209	261		0	13114	3254		429545	573	14796	50	44
1961	297	114		6	4684	5648		574533	3233	35730	56	48
1962	170	69		202	22079	16037		512817	8224	45312	62	43
1963		444		0	2612	17926	0	421780	10376	39603	68	45
1964	64	393			2295	9896	152	390328	5307	28931	67	46
1965	152	14013			858	14727	0	335156	4978	25504	64	49
1966	76	544			5054	7430	0	389062	1451	27333	61	44
1967	73	0			8707	21034	1918	375108	1338	47839	57	46
1968	22	1987			4580	10056	516	291050	2102	36132	49	39
1969	52	518			22222	6522	1866	264595	4919	57633	52	39
1970	867	0			46441	7416	0	405358	12914	36057	59	40
1971	0				43328	14643	229	409876	14092	20074	70	46
1972					26975	15387	20	536771	20821	28258	64	43
1973					16662	15146	161	588732	38372	8953	56	38
1974					9792	18956	0	713937	16360	3051	60	37
1975	0	0	0	0	2891	9744	764	684830	5635	27117	56	36

N.A. = Not available

(c) LESCHENAULT INLET

Year	Black bream	Buffalo bream	Cobbler	Cod	Cod mixed	Dusky flathead	Flounder	Sea garfish	Australian herring	Perth herring	Westralian jewfish	Yellowtail kingfish	Leather-jacket
1941	57								1805		1580		
1942	108							713	1151	596			
1943	155		450			8		77	786	4594			
1944													
1945													
1946	544		2081				3	382	246	1570			
1947		137	2932					158	9	177			
1948													
1949													
1950													
1951													
1952	31	0	14785	0	0	1	3	0	2467	8427	31	0	2
1953	66	0	3230		0	34	7	0	6903	45	36		32
1954	0	13	2158		23	18	6	142	7083	0	266		37
1955	20	0	11562		0	0	0	185	91	141	0		22
1956	59		6582					462	5174	1546			0
1957	1118		104209			0	0	861	2986	1853			
1958	3082		157546			11	17	477	5182	1185			
1959	737		36020			33	54	290	227	655			
1960	1760		9631			10	0	563	20	7978	0		
1961	1477		35780		0	35	81	2185	54	3015	3		
1962	3126		86233		14	91	77	712	0	2972	0		
1963	1157		33742		0	17	5	119		1204			
1964	483		9529		0	308	0	0		3872			
1965	0		7612			0		0	0	18295			
1966			2364					212	1356	7831			
1967			1324					0	470	4789			
1968			888					3	0	9017			
1969			1635	0		0		0	583	1887			
1970	0	0	1934	1178		6		23	425	1411		0	
1971	14	3946	9284	0		20	0	0	105	2650			
1972	0	0	5539			0	7	670	415	6753		45	
1973	768		9189			0	0	470	654	4306		0	0
1974	1710		14767			11	0	1538	85	22600		0	7
1975	238	0	20072	0	0	0	3	869	5304	8947	0	25	136
												0	10

(c) LESCHENAULT INLET

Year	Blue mackerel	Scaly mackerel	Dusky morwong	Mullet mixed	Sand mullet	Sea mullet	Yelloweye mullet	Mulloway	Yellowtail perch	Short-finned pike	Pilchard	Australian salmon	Samson fish	Shark, other
1941						33668	10521	1195		40		1438		104
1942						9481	33192	240				739		105
1943						3166	31965	164				293		
1944						4157								
1945						8767								
1946						4673	22528	103				67		504
1947						23763	12866	16	9			121		133
1948														
1949														
1950														
1951														
1952	0	0	0	0	0	16610	23214	288	154	134	0	551	0	341
1953			22			8517	31590	811	17	22		23		2776
1954			0			12878	23721	133	49	0		172		6084
1955						22638	34097	13	86		0	4		0
1956						14596	15528	172	0		211	1284		11620
1957						37296	26133	2129	0		0	1492	0	4984
1958						25148	63323	2209	151			50	586	0
1959						16977	65455	249	22			345	0	
1960						10235	34921	458	0			0		0
1961						23999	34609	59	16			1966		326
1962						31500	49990	376	0			396		0
1963				0		17486	35329	485	401			0	0	0
1964		0		38974		0	0	123	0			0	415	2322
1965		73		41584		0	0	0				179	0	5132
1966		0		0		8051	26593	440				4687	8	6644
1967						13829	39463	512				412	0	1166
1968						5704	31177	1172				0	0	0
1969		0				7206	24093	259	0			4815	32	212
1970		1218				8174	25946	35	30		0	848	0	0
1971		0				7226	13900	148	21		719	20	42	716
1972					0	16340	38469	131	0		304	6885	0	551
1973					2705	19416	44082	179			22	4521	0	226
1974	0				0	38792	43300	354			113	565	380	0
1975	83	0	0	0	23	36167	77095	180	0	0	0	45	0	135

1940															
1941															
1942															
1943															
1944															
1945															
1946				346											
1947	37			759	72										
1948															
1949															
1950															
1951															
1952	3	6	13354	549	2070	0	0	0	1003	19	84037	0	12	18	11
1953	69	23	3592	68	4210	204			2002	0	64299	176	0	20	12
1954	43	6	6900	216	1710	5704			897		68253	100		14	8
1955	0		437	346	974	2745			5090		78451	0		12	8
1956	105		4176	7	558	2487			4097		68664	0		13	8
1957	0		15301	0	4115	733			4608		207818	85		21	14
1958	64		6041	217	11169	6209			10654		293321	1238	0	23	15
1959	193		1681	0	0	6838			5574		135350	3089	297	22	14
1960	671		528		0	977			2194		69946	2542	0	15	10
1961	422		3845		1792	11436			8269	0	129369	5298		16	11
1962	0		4380		925	7975			14904	900	204571	3457		19	11
1963	36		7188		5633	947	0		14004	0	117753	3028		16	10
1964	0		1121		0	0	9062		0		66209	5136		15	10
1965			2534		637	0	3838		0	0	79884	3761		13	8
1966			3358		7516	428	0		4334	4100	77922	11810		10	8
1967			2346		5292	1273			5911	185	76972	15921		9	7
1968			1044	0	132	1583			4469	12	55201	8549	0	7	6
1969	0		1534	67	1001	367			1011	0	44702	8925	363	5	4
1970	153		986	0	6	3820		0	5238	0	51431	7987	0	10	7
1971	638		2432	0	0	13544		181	2959	5	58615	9967	850	9	7
1972	0		7589	166	222	6223		0	6165	25	96454	13097	4473	11	9
1973	149		5194	0	176	5749			6027	1877	105717	22141	0	12	9
1974	976		2577	17	0	9213			4165	192	141516	26392	0	14	11
1975	88	0	24115	582	1817	10615	0	0	14326	5892	206610	25150	545	14	11

(d) PRINCESS ROYAL HARBOUR AND KING GEORGE SOUND

Year	Anchovy	Bonito	Black bream	Buffalo bream	Cobbler	Cod	Southern rock cod	Dusky flathead	Flounder	Sea garfish	Groper	Australian herring
1964	0	0	0	0	6519	0	0	2135	244	0	0	10153
1965			195	15	13741			2610	2	3321	581	6180
1966			0	16	22046			2763	0	4692	336	100069
1967				0	17493			1148		3074	228	91440
1968	0				15959			1158	0	2745	16	76432
1969	355		0		14712	0	0	1285	14	2107	103	6191
1970	0	0	31	0	14131	270	10	694	0	4661	86	3363
1971		71	758	97	19596	71	0	478	0	2427	204	6807
1972	0	0	60	2318	15667	12	8	626	39	3711	634	30004
1973	454		925	749	16483	38	142	891	465	2152	52	41433
1974	35		574	0	12091	0	29	1207	6	2037	28	16170
1975	0	0	0	806	14945	33	61	1485	3	1016	45	15569

Year	Yellowtail perch	Short-finned pike	Pilchard	Australian salmon	Samson fish	Shark, other	Skates, rays, other	Snapper	Queen snapper	Snoek	Sweep	Tailor	Tarwhine (silver bream)
1964	0	525	0	12965	0	931	0	45	0	0	0	58	0
1965		360	28055	186	0	718		189				247	66
1966	0	256	6631	258677	151	2000		315				6	84
1967	74	0	14280	14228	78	5943		317				7	383
1968	14	0	5216	180163	0	752	0	0	0			0	0
1969	15	177	55634	7696		342	105	20	19		0	10	154
1970	0	909	91616	3332	0	2175	384	958	112		92	0	0
1971	55	136	19659	588	836	3526	363	397	116	0	22		282
1972	0	111	18559	2540	114	1261	281	190	38	110	73	0	53
1973		128	36	13018	194	835	136	25	19	22	78	253	271
1974		376	30935	1665	22	330	0	1088	18	0	0	0	0
1975	0	114	134561	52	156	1262	167	250	52	32	78	1	0

(d) PRINCESS ROYAL HARBOUR AND KING GEORGE SOUND

Year	Perth herring	Westralian jewfish	Yellowtail kingfish	Leather-jacket	Scaly mackerel	Red mullet	Sand mullet	Sea mullet	Yelloweye mullet	Mulloway
1964	0	0	0	0	0	0	0	0	0	0
1965		242	119	2862	0			4071	2546	7
1966		26	134	6974	644			2141	62294	136
1967		37	156	9593	3289			7344	33187	56
1968		0	0	1890	940			8394	36009	15
1969		6		5227	6577			1286	102947	23
1970		0		5249	0			2361	14122	0
1971		123	0	4115	4934		0	2137	43724	1887
1972	0	25	295	10728	10889	0	100	2663	25087	48
1973	1187	6	5	8634	0	5	146	1991	4098	67
1974	2390	0	869	8944		9	519	3125	14598	952
1975	0	302	13	6134	0	7	0	5274	14244	0

Year	Southern trevally (skipjack)	Southern bluefin tuna	King George whiting	Trumpeter whiting	Western sand whiting	Other wetfish	Total wetfish	Crabs	Prawns	Men	Boats
1964	58	0	0	0	0	0	33633	14	0	10	8
1965	944	188	3105		920	27	71497	312		15	11
1966	483	0	3714		353	1750	476691	0		20	14
1967	1224		5251		229	3109	212169			17	12
1968	457	0	6320		13	2508	339001			16	11
1969	497	38809	4459		73	800	249643	0	0	16	12
1970	434	313	3874	0	120	0	149297	4	96	13	10
1971	69	36922	5454	15	51	247	156167	6	0	14	9
1972	921	157	5597	0	6	227	133152	0	0	15	9
1973	665	0	6042		714	20	102429		531	14	8
1974	988		4378		19	9	103411		282	14	9
1975	310	0	3182	0	520	39	200713	0	0	19	11

(e) OYSTER HARBOUR

Year	Barracouta	Bonito	Black bream	Buffalo bream	Bream mixed	Cobbler	Cod	Cod mixed	Dusky flathead	Flounder	Sea garfish	Groper
1964	188	0	0	0	2191	3869	0	0	1283	0	0	0
1965	0		536		0	5690			1033		552	
1966			1236			6480			1201		648	
1967			305			2821			534		228	
1968			760			8488			731		438	
1969			261	0		6283			681	0	5029	0
1970			0	363		10342		0	218	22	1816	72
1971			117	42		6579	0	42	430	0	459	379
1972			109	20		6222	33	0	439		759	14
1973			0	0		5525	156		201		1203	1872
1974		0	0	23		2580	0		151		662	15
1975	0	79	188	0	0	3988	10	0	549	0	457	0

Year	Short-finned pike	Pilchard	Australian salmon	Samson fish	Shark, other	Skates rays, other	Snapper	Queen snapper	Snoek	Sole	Sweep	Tailor	Tarwhine (silver bream)
1964	0	0	73	1006	2703	0	90	0	0	171	0	62	0
1965			133	0	82		0		6	0		29	9
1966			255		180				0			109	86
1967			270		883							100	33
1968	0		417		121							24	0
1969	459	0	2199	0	86						0	68	23
1970	11	16847	308	1842	1845	0	0	0			193	0	14
1971	0	0	39416	2384	870	98	416	6			0	56	0
1972	14		11807	354	9567	172	89	85			17	14	
1973	0	0	9509	7128	9063	0	212	238			105	29	0
1974	12	999	7127	205	62		0	26			0	0	22
1975	0	100	9	0	62	0	0	0	0	0	0	12	0

(a) [illegible]

Year	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Year	Other jacks	Southern trevally (skipjack)	Southern bluefin tuna	King George whiting	Whiting mixed	Western sand whiting	Other wetfish	Total wetfish	Crabs	Prawns	Men	Boats
1964	1894	35	0	0	647	0	3250	23628	45	0	7	3
1965	0	1039		653	0	152	4435	19615	21		5	4
1966		1258		314		25	37	18416	11		5	4
1967		957		132		0	8	14495	0	0	4	3
1968		1274		429		132	397	22144	0	866	5	4
1969		407	0	811		67	27	26980	0	0	5	3
1970		415	6999	981		705	67	57081	13		8	4
1971		259	20635	2298		314	69	179619	18		8	4
1972		4368	48305	1207		0	469	118975	20	0	6	4
1973		2403	0	2311		198	40	137160	943	368	5	3
1974		769	0	1688		0	0	73800	0	130	5	3
1975	0	1160	6835	868	0	148	0	28859	37	0	6	4

(f) WILSON INLET

Year	Black bream	Buffalo bream	Bream mixed	Cobbler	Cod	Southern rock cod	Dusky flathead	Flounder	Sea garfish	Groper	Australian herring	Herring mixed	Perth herring	Westralian jewfish	Yellow-tail kingfish
1941	1266			86			4582		3483						
1942	16			1662			2128		1844						
1943	25			2464			1852		121						
1944	43			2042			3254		6452						
1945	17			3702			7392		2610						
1946	144			935			3471		538						
1947	444			1365			4590		745						
1948	10			394			7526		158						
1949	92			1515			8709		688						
1950	563			7854			8995		1112						
1951	2327			1732			8645		87						
1952	291	0	1274	3837	0	0	7027	34	635	8	8558	0	0	0	0
1953	30		0	3689	50		5355	129	1659	42	7420				
1954	62			3306	0		8434	1653	298	9	5169				
1955	1589			24244			22657	238	383	0	4843				
1956	202			13266			13405	2	177	0	7534				
1957	166			9493	0		6017	565	258	62	10203				
1958	393			11509	4		8292	3305	2091	5	11047				
1959	1016	0		10384	23		7925	625	1584	11	8394				
1960	406	98		13836	0		4936	526	454	2	1660				
1961	109	0		6860			1727	146	1191	9	1772			0	
1962	346			18113	0		1518	769	461	0	4595			3	
1963	104		0	14656	38		2755	615	965	29	9508	0		47	
1964	0		60	10102	0		2957	0	0	0	8861	2321		0	0
1965	175		0	9337			2483	213	4824	3	8298	0			29
1966	188			14107			1259	264	4484	0	12088			0	0
1967	804			10612			2229	235	1925	4	13915			4	
1968	1924			14783			2564	114	3760	158	12217			0	
1969	22			13543			1931	149	1586	33	6643				
1970	104	0		15864			2185	255	5134	0	12482				
1971	29	145		18986			3882	2	7866	0	58210				
1972	49	548		12235		0	7789	135	2467	8	7713				
1973	0	2		27586		2	11866	374	6895	32	5032		0		
1974	5	0		26287		0	9961	114	6000	4	2723		2167		
1975	9	0	0	58130	0	0	14065	400	7164	52	3112	0	0	0	0

[illegible]

[illegible]					[illegible]	[illegible]								
[illegible]					[illegible]	[illegible]								
[illegible]					[illegible]	[illegible]								
[illegible]					[illegible]	[illegible]								
[illegible]					[illegible]	[illegible]								
[illegible]					[illegible]	[illegible]								
[illegible]					[illegible]	[illegible]								
[illegible]					[illegible]	16778								
[illegible]					[illegible]	27837								
[illegible]					[illegible]	[illegible]								
[illegible]					[illegible]	[illegible]								
1952	5	0	0	0	4826	5314	0	11	1	0	16007	0	413	0
1953	[illegible]				3502	11831		170	0		[illegible]		[illegible]	
1954	[illegible]				2791	[illegible]	0	0			[illegible]		409	
1955	[illegible]				2260	9335	23				145	0	[illegible]	
1956	[illegible]				1244	890	15		0		616	36	33	0
1957	300				12534	8332	0		2		263	0	161	84
1958	26				7705	18142	44		5		160	56	54	0
1959	209				12681	18805	98		27		205	0	154	
1960	33				5520	17549	8		14	0	24		10	
1961	62				5476	12047	0	0	0	777	2455	0	6	
1962	4				3831	3667		30	62	1375	130134	95	1144	
1963	587	0	0		8646	14176		259	20	4101	21097	0	3379	
1964	0	9	15206		0	0	0	0	0	0	91		0	
1965	13	0	0		4995	9989	20				10492		99	
1966	0				4150	7655	18				797		28	
1967					3135	11729	13			0	225		462	
1968					6321	23394	29			5	2345		2158	
1969	0				1791	11332	0			0	506		719	
1970	19				3113	7457			0	0	43		0	
1971	180				4774	8258			17	1449	90		0	
1972	249			0	2902	5007			0	231	127		98	
1973	263			144	1872	5380				0	128	0	0	0
1974	1614			757	15700	3649	0			2853	172	20	0	1844
1975	1118	0	0	0	17005	12632	37	0	0	100	33	18	12	0

(f) WILSON INLET

Year	Snapper	Queen snapper	Sole	Sweep	Tailor	Tarwhine (silver bream)	Other jacks	Southern trevally (skipjack)	Southern bluefin tuna	King George whiting	Western sand whiting	Other wetfish	Total wetfish	Crabs	Prawns	Men	Boats
1941										21848	2914		78533				
1942										3584	185		36993				
1943										199	509		16096				
1944										246	2870		37052				
1945										5117	3778		74892				
1946										8136	2315		28035				
1947										1778	6248		37064				
1948	1585									3866	1252		34312				
1949	1359									7080	1481		51799				
1950	2153									5766	1229		45499				
1951	1060									3748	4718		35532				
1952	8235	0	0	0	3	160	0	536	0	5258	7200	15	69686	0	0	11	8
1953	4808			75	39	502		471		18383	1234	0	478131			15	8
1954	2317			0	1	369		96		9401	140	0	88495			9	6
1955	1251				48	146		44		4646	2090	18	74636		0	14	10
1956	64			0	342	65		204		180	71	0	38346	0	11	10	8
1957	38			1	254	111		783		970	0		50597	2	237	10	8
1958	340			0	266	381		1413		7714	406		73358	0	0	14	12
1959	159				93	595		28		7292	0		70308			10	9
1960	350				13	31		25		3605	0		49100			9	9
1961	127				2001	163		17	0	3337	11		38293			6	7
1962	115	0		0	544	20		229	9	473	25		167562			9	6
1963	1398	64		2	33	84	0	779	0	2227	478	0	86047			10	8
1964	1038	0	0	0	126	0	853	54		5230	0	1020	47928			10	8
1965	4989		146		92	970	0	1193		5492	122	1679	65653		0	10	8
1966	1377		0		30	510	0	317		2648	208	1553	51681	0	1487	10	8
1967	1382				37	775	2080	0		3455	79	2365	55465	1325	0	9	7
1968	560				8	738	0	2024		6699	50	917	80768	0		12	10
1969	78	0			4	1419		1024		4654	345	1024	46803	45		11	9
1970	144	11			0	698		273		3419	58	113	51372	2277		8	5
1971	9	0			21	81		305		3111	38	25	107478	0		7	5
1972	12				35	14		1447		2797	37	0	43900		0	6	5
1973	5	0			414	6		299		2894	37	323	63554		56	6	5
1974	47	22			33	542		347		4387	0	0	79248	0	0	8	7
1975	465	0	0	0	118	122	0	246	0	10448	130	42	125458	17	22	10	8

(g) IRWIN INLET

Year	Anchovy	Black bream	Buffalo bream	Cobbler	Cod mixed	Dusky flathead	Flounder	Sea garfish	Groper	Australian herring	Westralian jewfish	Leather-jacket	Mullet mixed	Sea mullet
1940														
1941		761				38		1185		1276		71		1992
1942		68		7				386		240				1406
1943		136		15				48						200
1944														
1945														
1946		784		24				601		2802				73
1947		86				36		100		178				57
1948														
1949														
1950														
1951														
1952														
1953						12				3724				1352
1954										662				671
1955										1637				562
1956														
1957														
1958														
1959														
1960														
1961														
1962														
1963														
1964	0	0	0	64	0	0	0	0	0	118	0	0	1483	0
1965		320		286		39	5	91		39			0	677
1966		176		201		20	10	115		728				920
1967		253		251		67	5	19		604				355
1968		0		59	0	0	0	20		198				967
1969		112		153	1	15	5	0		82				1169
1970	0	170		141	0	0	7	10	0	18	0	0		1401
1971	25	438	0	471		20	0	0	275	714	42	16		356
1972	0	292	12	536		42	12	1763	0	2260	0	9		1005
1973		0	0	112		7	0	878		853		0		594
1974		19	0	4		0		10		55		0		823
1975	0	354	100	170	0	14	0	509	0	2102	0	14	0	1460

(g) IRWIN INLET

Year	Yelloweye mullet	Mulloway	Pilchard	Australian salmon	Shark, other	Skates rays, other.	Snapper	Snoek	Sole	Tailor	Tarwhine (silver bream)	Other jacks	Southern trevally (skipjack)	King George whiting
1940														
1941	2563			1026			73			25	1908		2225	5295
1942	2709	13		453			11				49		493	437
1943	1161			706									91	2300
1944														
1945														
1946	7006	83		1192			480			34	23		872	
1947	739	355		115			24						148	795
1948														
1949														
1950														
1951														
1952														
1953	3507													
1954	523													3542
1955	404													3260
1956														2700
1957														
1958														
1959														
1960														
1961														
1962														
1963														
1964	0	0	0	38	0	0	11	0	0	22	1071	25	0	0
1965	441	11		86	9		0		4	12	396	0	52	324
1966	1670	164		674	0				0	18	569		522	2467
1967	494	10		270	321		0			0	36		0	1311
1968	427	19		150	0		3			0	147		48	812
1969	7593	0	0	553			0			20	914		180	217
1970	566	0	1270	171	0	0	0			0	193		23	2422
1971	342	21	0	198	1845	211	84			0	6		0	243
1972	2469	0		11	286	0	0			42	214		62	743
1973	2044	22		20	266	23	10			7	420		145	404
1974	424	0		0	0	0	0	0		52	49		33	45
1975	1295	0	0	211	0	0	487	7	0	46	424	0	238	900

(q) IRWIN INLET

Year	Whiting mixed	Western sand whiting	Other species	Total	Crabs	Nets	Boats
1940							
1941			45	18483			
1942				6272			
1943				4057			
1944							
1945							
1946		1339		15313			
1947		2		2635			
1948							
1949							
1950							
1951							
1952							
1953				10785			
1954				5116			
1955				5303			
1956							
1957							
1958							
1959							
1960							
1961							
1962							
1963							
1964	3053	0	159	6044	0	3	2
1965	0	0	0	2792		2	2
1966		758		9012	0	2	2
1967		0	0	3996	55	2	2
1968		21	19	2890	0	3	2
1969		0	5	11019	0	3	2
1970	0		0	6402	29	2	2
1971	24		8	5339	0	1	1
1972	0		0	9758	169	2	1
1973				5805	23	1	1
1974			0	1514	0	1	1
1975	0	0	444	8775	350	3	2

(h) BROKE (BROOK'S) INLET

Year	Bonito	Black bream	Buffalo bream	Cobbler	Dusky flathead	Flounder	Garfish	Groper	Australian herring	Perth herring	Westralian jewfish	Leather-jacket	Mullet mixed	Sea mullet
1941									16					
1942									87					11
1943					27				566					125
1944														
1945														
1946														
1947					21	2			509					475
1948				11	10				1145					495
1949														
1950														
1951														
1952														
1953									329					793
1954							15		571					1020
1955				3			5		1033					1009
1956				324			5		4095					25
1957							47		734					1125
1958							2		1021					1633
1959							0		23					721
1960									328					88
1961									668					460
1962									78					969
1963									45					182
1964	0	0	0	0	0	0	0	0	0	0	0	0	1406	0
1965	|	|	|	|	3	|	|	|	16	|	|	|	0	92
1966	|	0	|	0	10	0	|	|	41	|	|	|	|	123
1967	|	10	|	1	5	6	|	|	9	|	|	|	|	153
1968	|	100	|	8	0	7	|	|	32	|	|	|	|	584
1969	|	8	|	0	2	5	|	|	71	|	|	|	|	706
1970	|	1	|	2	0	8	|	|	277	|	|	|	|	452
1971	|	49	|	2	0	0	|	|	0	|	|	0	|	578
1972	|	6	0	3	2	|	|	|	5	|	|	1	|	332
1973	0	433	246	0	0	|	|	0	62	0	0	0	|	2880
1974	5	16	0	6	45	|	|	133	33	9	76	|	|	705
1975	0	35	0	37	14	0	0	0	302	0	0	0	0	486

(h) BROKE (BROOK'S) INLET

Year	Yelloweye mullet	Mulloway	Yellowtail perch	Short-finned pike	Pilchard	Australian salmon	Shark other	Snapper	Sweep	Tailor	Tarwhine (silver bream)	Southern trevally (skipjack)	King George whiting
1940													
1941	1192					44							166
1942	1285					54							142
1943	2557					87				11		87	152
1944													
1945													
1946													
1947	238		69			219					92	36	
1948	2020					579				2	22	207	174
1949													
1950													
1951													
1952													
1953	25071												2186
1954	25946					59				141	65	47	4086
1955	8182					120				2	635	3	4039
1956	10807					296				165	660	1925	697
1957	14250					228				430	407	377	10155
1958	6926					106				225	1072	287	5349
1959	696					53				4	0	0	168
1960	5121					0				6	4	42	663
1961	2430					755				135	0	118	651
1962	1309					664				90	7	10	691
1963	227					132				276	61	0	144
1964	0	0	0	0	0	0	0	0	0	63	0	0	0
1965	2135	14	|	|	|	25	|	0	|	13	|	11	69
1966	3493	60	|	|	|	40	0	11	|	23	0	14	93
1967	5345	195	0	|	|	184	14	0	|	82	26	5	474
1968	10625	292	3	|	|	381	0	6	|	77	78	35	358
1969	8615	17	0	|	|	88	|	29	|	11	2	49	391
1970	6896	0	|	|	|	36483	|	5	|	3	18	36	1199
1971	10946	|	|	|	|	369	|	0	|	10	5	0	2149
1972	12017	0	|	|	|	70	|	|	|	0	17	0	248
1973	6519	5	|	0	0	31	0	|	0	8	14	11	132
1974	6218	31	|	28	590	7499	33	|	2	11	8	0	112
1975	2267	0	0	0	0	0	0	0	0	0	5	1	686

(b) BROKE (BROOK'S) INLET

Year	Whiting mixed	Western sand whiting	Other wetfish	Total wetfish	Crabs	Prawns	Men	Boats
1941				1418			2	1
1942				1579			2	1
1943				3612			2	1
1944								
1945								
1946								
1947	77			1738				
1948		27		4692				2
1949								
1950								
1951								
1952								
1953			1580	29959			11	
1954			23	31973			8	
1955			180	15211			4	
1956			284	19283			8	
1957			47	27800				
1958			70	16691				
1959			2	1667				
1960			460	6732				
1961			33	5250				
1962			147	3965				
1963			0	1067				
1964	45	0	23	1537	0	0	1	1
1965	0	|	0	2378	|	0	1	1
1966	|	|	0	3908	0	5085	3	1
1967	|	0	20	6529	88	0	1	1
1968	|	460	0	13046	0	0	3	2
1969	|	0	24	10018	|	16	2	1
1970	|	24	10	45414	|	0	2	1
1971	|	143	0	14251	|	|	1	1
1972	|	32	|	12733	|	|	2	2
1973	|	43	0	10384	|	|	3	2
1974	|	9	29	15598	|	|	3	2
1975	0	7	0	3840	0	0	1	1

TABLE 4 RECORDS OF A * SINGLE FISHERMAN'S CATCH FROM THE FALLINGE ESTUARY (BEAUFORT INLET) OVER THE PERIOD 1945-1954.

YEAR	BLACK BREAM	SEA MULLET	YELLOWEYE MULLET	AUSTRALIAN SALMON (TROUT)	OTHER	TOTAL	EFFORT (DAYS FISHED)	COMMENT
1945	7695	308				8004	48	In 1944 all fish except black bream died.
1946	2568					2568	20	All other species too small to catch legally.
1947	5899	8802	(NOT FISHED)	251		14952	50	Good fishing year.
1948	2493	10900	2995	892	304	17585	56	Good fishing year.
1949	784	9719	3019		261	13737	49	Good fishing - bar broke.
1950	3294	2163	799		210	6467	18	Poor season. Most species too small to catch legally.
1951	3242	5040	2099	50	304	10735		By late winter, water level low, fish in poor condition. Invertebrates dying.
1952	NIL							All fish had died by the winter of 1952.
1953	NIL							February floods - bar broke. Constant flooding throughout winter prevented fishing.
1954	523	9841	(NOT FISHED)	355	295	11014	56	

* 3 - 4 other parties also fish the estuary.

TABLE 5. THE LIFE HISTORY STRATEGIES, AND THE USUAL MAGNITUDE OF ANNUAL CATCHES OF EACH OF THE COMMERCIAL SPECIES TAKEN IN THE ESTUARINE FISHERIES OF TEMPERATE WESTERN AUSTRALIA.

Life history strategy	Species	Annual catch (kg) from all commercial estuaries			
		<1 000	1 000-10 000	10 000-100 000	>100 000
Estuarine-populations mainly juvenile from marine - spawning.	Garfish, sea		x		
	Mullet, sand		x		
	Mullet, sea				x
	Mullet, yelloweye				x
	Mulloway			x	
	Salmon, Australian			x	
	Snapper		x		
	Tailor			x	
	Tarwhine (Silver bream)		x		
	Trevally			x	
	+Trumpeter	x			
	Whiting, King George			x	
	Whiting, Western sand			x	
Entire life cycle within estuary	*Anchovy/whitebait			x	
	Bream, black		x		
	*Cobbler				x
	*Flathead			x	
	+*Flounder	x			
	Herring, Perth				x
	Perch, yellowtail		x		
	+Roach	x			
Occasionally present in estuaries as adults	Barracouta (snock)	x			
	Bonito	x			
	Bream, buffalo	x			
	Cod	x			
	Cod, southern rock	x			
	Grouper		x		
	Herring, Australian				x
	Jewfish, Westralian	x			
	Kingfish, yellowtail	x			
	Leatherjackets			x	
	Mackerel, blue	x			
	Mackerel, scaly		x		
	Morwong, dusky	x			
	Mullet, red	x			
	Pike, short finned	x			
	Pilchard				x
	Redfish	x			
	Samson fish		x		
	Shark		x		
	Skates	x			
	Snapper, Queen	x			
	Sole	x			
	Sweep	x			

*Provided conditions are favourable, these species can reproduce and mature entirely within the estuarine environment.

+ Catches of these species are low because they either are not in great demand commercially or they mostly occur in areas where commercial fishing is difficult or not permitted.

TABLE 6 THE NUMBER OF FAMILIES AND SPECIES OF THE CLASSES TELEOSTOMI, ELASMOBRANCHII, PETROMYZONES, AND OF COMMERCIALLY IMPORTANT CRUSTACEA RECORDED FROM THE DIFFERENT CATEGORIES OF ESTUARINE SYSTEMS OF TEMPERATE WESTERN AUSTRALIA.

			WEST COAST			SOUTH COAST			
	Families	Species	*PO	SC	NC	PO	SC	NC	PC
TELEOSTOMI									
Freshwater native	4	9	4	4		4	4	3	1
Freshwater introduced	6	8	7	1		2	3		
Estuarine	3	4	4	4	2	4	4	3	3
Estuarine/Marine	70	161	97	12	10	103	50	35	1
Total	†79	183	112	21	12	113	61	41	5
ELASMOBRANCHII									
Estuarine	1	1	1						
Estuarine/Marine	9	12	3			9	1		
Total	10	13	4			9	1		
PETROMYZONES									
Estuarine/Marine	1	1	1			1	1		
CRUSTACEA (commercial)									
Estuarine	1	1	1			1			
Estuarine/Marine	2	2	2		1	1	2	1	
Total	†2	3	3		1	2	2	1	

*PO = permanently open system
SC = seasonally closed system
NC = normally closed system
PC = permanently closed system
† = Some families are represented in more than one of the four groups of teleost and two groups of crustacean species respectively.
Reproduced from Hodgkin E.P.; and Lenanton R.C.J. (1981)

TABLE 7. COMPARISONS OF THE ESTUARINE CATCHES (KG) OF THE MOST IMPORTANT COMMERCIAL ESTUARINE SPECIES WITH THE TOTAL STATE CATCH OF THESE SPECIES IN EACH OF THE YEARS 1965, 1970 AND 1975.

	1965			1970			1975		
	Total Catch		% Estuarine / State	Total Catch		% Estuarine / State	Total Catch		% Estuarine / State
	Estuarine	State		Estuarine	State		Estuarine	State	
Yelloweye mullet	163 042	250 788	65.01	261 888	315 950	82.89	440 619	487 809	90.33
Sea mullet	176 553	480 799	36.72	202 015	392 416	50.48	359 822	617 877	58.24
Cobbler	73 945	94 683	78.10	126 626	133 485	94.69	180 270	190 564	94.60
Perth herring	66 645	117 668	56.64	66 206	95 004	69.69	148 943	157 393	94.63
King George whiting	10 501	14 199	73.96	62 219	72 072	86.33	29 590	38 685	76.49
Western sand whiting	15 931	198 236	8.04	13 617	194 682	6.99	24 905	160 467	15.52
Australian herring	18 938	373 481	5.07	17 259	623 322	2.77	31 028	790 613	3.92
Tailor	24 389	91 261	26.72	14 589	48 179	30.28	48 044	82 007	58.59
Mulloway	1 784	24 758	7.21	3 716	6 690	55.55	31 337	43 802	71.54
Flathead	7 330	7 937	92.35	6 187	7 268	85.13	17 143	17 670	97.02
Anchovy/whitebait	8 366	36 133	23.15	4 944	49 132	10.06	17 619	87 608	20.11
Garfish	9 443	25 866	36.51	12 557	24 001	52.32	14 248	40 469	35.21
Trevally	18 148	51 868	34.99	1 187	17 960	6.61	3 772	11 782	32.01
Pilchard	30 936	68 605	45.09	110 739	228 088	48.55	171 926	979 534	17.55
Leatherjacket	2 885	11 601	24.87	8 993	9 443	95.23	12 382	22 132	55.95
Total wetfish	628 836	1 847 883	34.03	912 742	2 217 962	41.15	1 534 958	3 728 412	41.17
Crabs	10 820	12 540	86.28	26 540	32 680	81.21	52 438	80 905	64.81
Prawns	27 811	940 484	2.96	37 439	3 111 143	1.20	30 852	4 449 250	0.69
Fishing effort Man-months	1 619			1 541			1 642		
Boat-months	1 245			1 114			1 152		
Total State catch all wet fish species		4 758 765			6 153 959			8 033 662	

Figure 1. The commercially coded estuaries of temperate Western Australia, prior to June 1977.

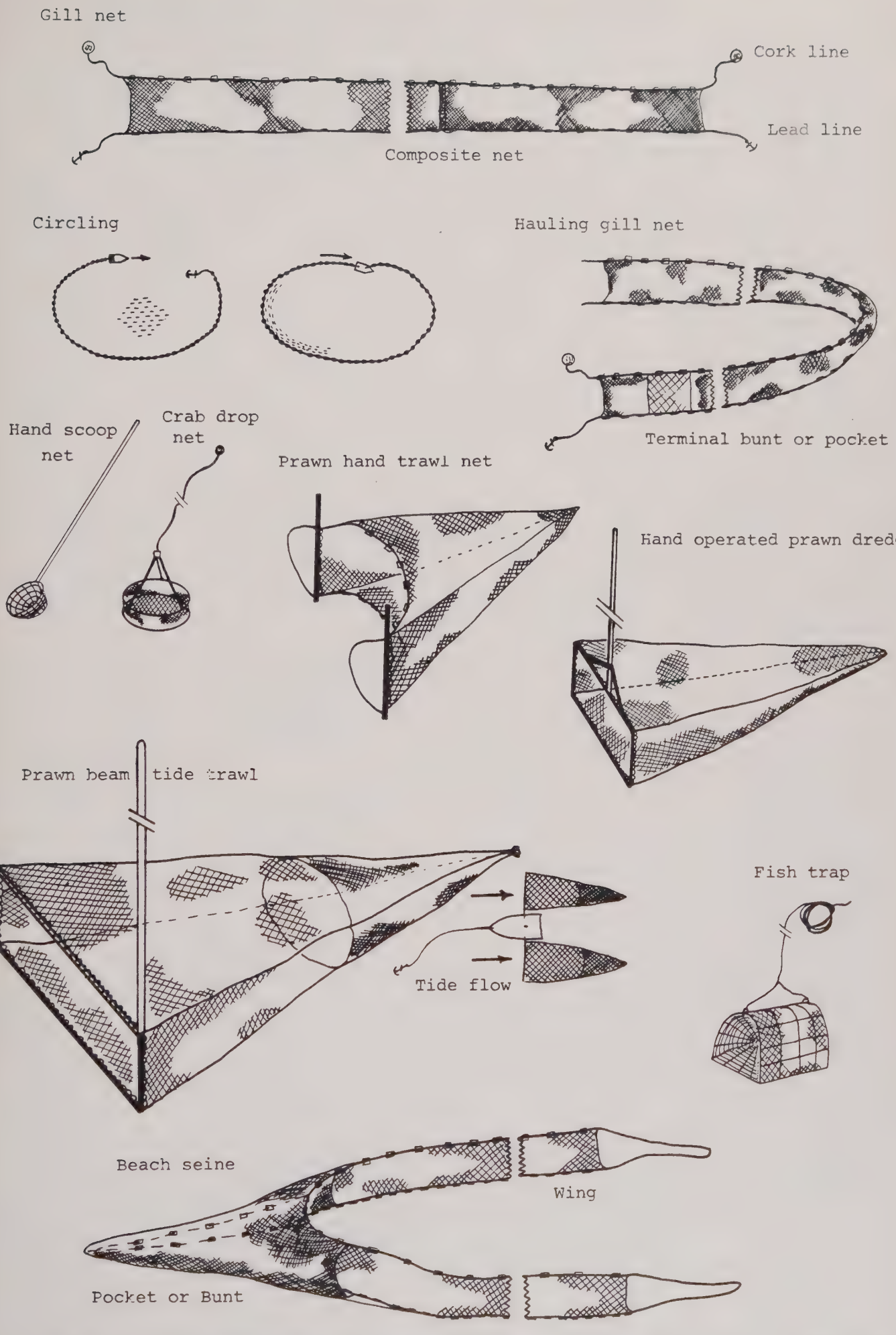

FIGURE 2 ILLUSTRATIONS OF THE BASIC TYPES OF FISHING GEAR USED IN ESTUARIES BY BOTH PROFESSIONAL AND AMATEUR FISHERMEN

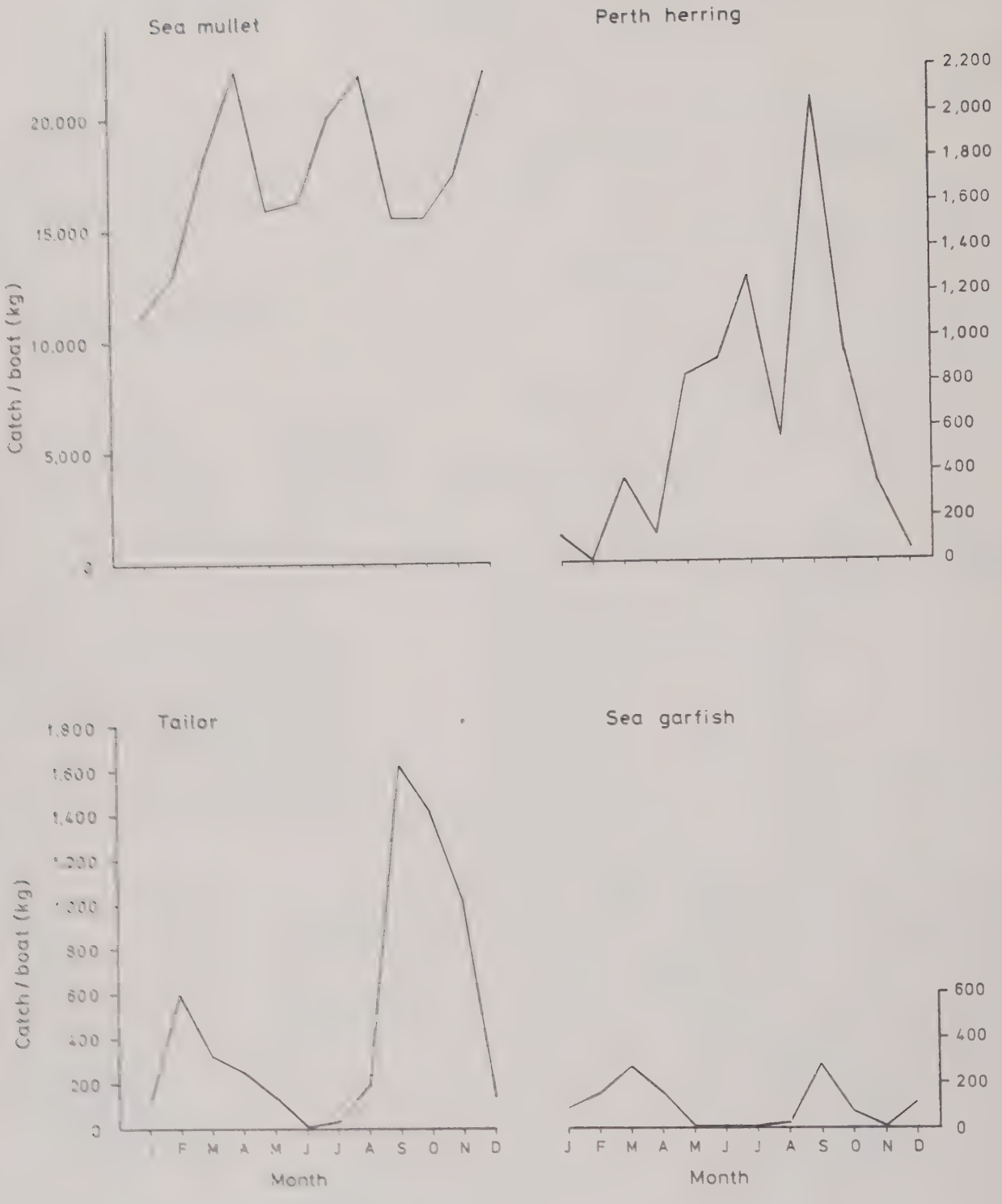

Figure 3 The average monthly catch rates of four commercial fish species ranging from extremely euryhaline (sea mullet) to practically stenohaline (sea garfish), taken from the Peel-Harvey estuary over the period 1972-74 (incl.).

Appendix 1 Guidelines for the interpretation of the species included under the various common names used in the Australian Bureau of Statistics fish production figures.

Common Name	Commercial Block 9501	9502	9503	9508	9507	9506	9505	9504
Anchovy	*Engraulis australis*							
Barracouta (or Snoek)	*Leionura atun*							
Bonito	*Sarda orientalis*				*Sarda australis*			
Bream black	*Acanthopagrus butcheri*							
Bream buffalo	*Kyphosus sydneyanus*							
	Kyphosus cornelii							
Bream mixed	*Acanthopagrus butcheri*							
	Rhabdosargus sarba							
Catfish	*Cnidoglanis macrocephalus*							
	Tandanus bostocki							
Cobbler	*Cnidoglanis macrocephalus*							
Cod	*Epihephelides armatus*							
Cod mixed	*Epinephelides armatus*							
	Acanthistius serratus							
					Physiculus barbatus			
Cod southern rock					*Physiculus barbatus*			
Flathead dusky					*Platycephalus speculator*			
	Platycephalus longispinis							
					Platycephalus sp.			
	P. endrachtensis							
	Platycephalus haackei							
	P. isacanthus							
	Platycephalus laevigatus							
Flounder	*Pseudorhomous jenynsii*							
					Ammotretis rostratus			
Garfish sea	*Hyporamphus melanochir*							
	Hemiramphus regularis regularis							
Grouper	*Achoerodus gouldii*							
Herring Australian	*Arripis georgianus*							
Herring mixed	*Arripis georgianus*							
	Nematolosa vlaminghi							
Herring Perth	*Nematolosa vlaminghi*							
Jewfish Westralian	*Glaucosoma hebraicum*							
Kingfish yellow-tail	*Seriola grandis*							
Leatherjacket	*Fam. Monocanthidae*							
Mackerel blue	*Scomber australasicus*							
Mackerel scaley	*Amblygaster postera*							
Morwong dusky	*Psilocranium nigricans*							
Mullet mixed	*Mugil cephalus*							
	Aldrichetta forsteri							
Mullet red	*Upeneichthys porosus*							

Common Name	Commercial Block 9501	9502	9503	9508	9507	9506	9505	9504
Mullet sand				*Myxis elongatus*				
Mullet sea			*Mugil cephalus*					
Mullet yelloweye			*Aldrichetta forsteri*					
Mulloway			*Argyrosomus hololepidotus*					
Perch Yellowtail	*Amniataba caudavittatus*							
Pike short-finned			*Australuzza novaehollandiae*					
Pilchard			*Sardinops neopilchardus*					
Redfish			*Centroberyx affinis*					
Roach	*Gerres subfasciatus*							
Salmon Australian			*Arripis trutta esper*					
Samsom fish			*Seriola hippos*					
Shark	Most important commercial species i.e. *Mustelus antarcticus, Furgaleus ventralis, Carcharhinus spp., Orectolobus spp.*							
Shark other	Incidental captures of less important species.							
Skates, rays other	Fam. Rajidae, Order Myliobatiformes							
Snapper			*Chrysophrys unicolor*					
Snapper Queen			*Nemadactylus valenciennesi*					
Sole			Fam. Soleidae					
Sweep			*Scorpis aequipinnus*					
			Scorpis georgianus					
Tailor			*Pomatomus saltatrix*					
Tarwhine			*Rhabdosargus sarba*					
Trevallyeastern				*Caranx nobilis*				
Trevally other jacks			Probably *Trachurus mccullochi*					
Trevally southern			*Pseudocaranx wrighti/P.dentex*					
Trumpeter			*Pelates sexlineatus*					
Tuna skipjack			*Katsuwonus pelamis*					
Tuna southern bluefin			*Thunnus maccoyii*					
Whitebait			*Hyperlophus vittatus*					
Whiting King George			*Sillaginodes punctatus*					
Whiting mixed			*Sillaginodes punctatus*					
			Sillago schomburgkii					
	Sillago maculata							
Whiting trumperter	*Sillago maculata*							
Whiting western sand			*Sillago schomburgkii*					
Wetfish other								
Crabs			*Portunus pelagicus*					
Prawns			*Penaeus latisulcatus*					
	Metapenaeus dalli							
Octopus				*Octopus sp.*				
Squid				*Loligo sp.*				

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